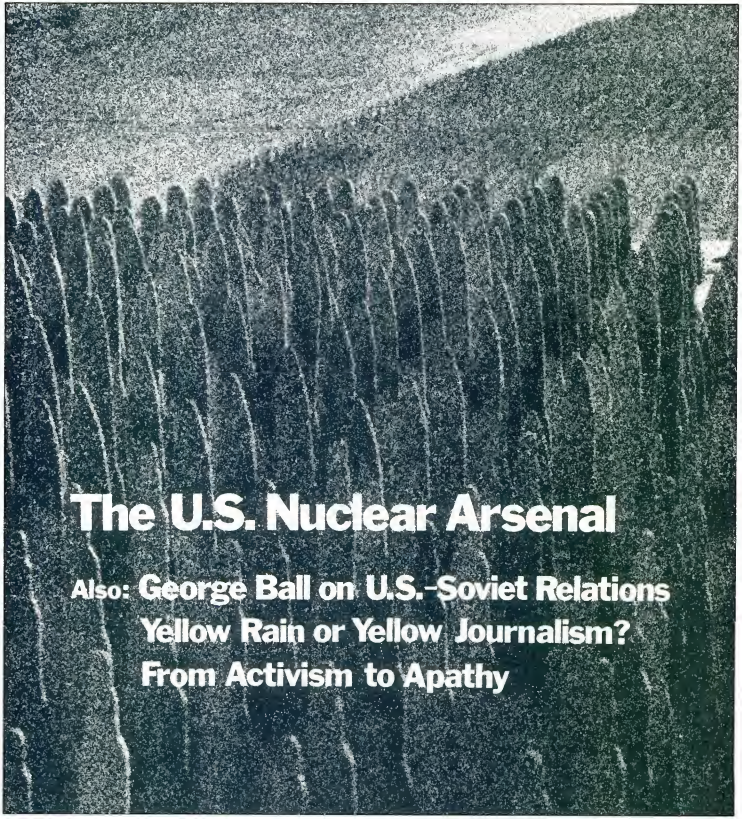
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of the Atomic Scientists

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The U.S. Nuclear Arsenal

Also: George Ball on U.S.-Soviet Relations

Yellow Rain or Yellow Journalism?

From Activism to Apathy

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INSIDE PUGWASH NEWSLETTER

Special newsletter for Bulletin readers on the Pugwash conferences

Sept. vol. 2, no. 1

Statement issued after Pugwash meeting

Committee calls for informal talks and independent initiatives

There has been a great deal of Pugwash activity since our last report in this space in June. Two workshops and a major conference have taken place in Europe. We will report on the Denmark workshop and the major conference in Sweden in future months. In this issue we will cover the news from the Geneva workshop: *Nuclear Forces and Proposals for Nuclear-Weapons Freeze.*

42 eminent scientists attended the Geneva workshop in June. Most were Pugwash 'old hands', known to one another, and able to work well together to hammer out new ideas. This, of course, is the Pugwash tradition. For over twenty years scientists have been meeting, without publicity or fanfare, to develop concrete solutions to the most pressing problems of our time.

In attendance were scientists and military people from Belgium, China, Denmark, the Federal Republic of Germany, Finland, France, Hungary, Ireland, Italy, the Netherlands, Poland, Switzerland, the United Kingdom, the United States and the Soviet Union.

Following the meeting, the Pugwash Executive committee issued a statement summarizing the key points which emerged from the workshop.

Key points of Geneva Statement

- The two sides should pursue informal talks and independent initiatives to create conditions under which formal talks would be fruitful.
- The first initiative should be immediate pauses in all nuclear deployments in Europe on both sides.
- Other independent initiatives suggested: withdrawal of nuclear weapons to a distance of 100 kilometers from the NATO/Warsaw Pact boundary; renunciation of "decapitation" and "launch on warning" strategies; moratoria on testing and deployment of anti-satellite weapons.
- The superpowers should establish a pattern of regular, private, informal meetings of political and military leaders.
- Nations should agree to freeze the testing, production, and deployment of nuclear weapons, as thoroughly and as soon as possible.
- Early steps towards this freeze could be implemented at once: a comprehensive ban on the testing of nuclear explosives, anti-satellite weapons, and on flight tests of new land-based and sea-based ballistic missiles.
- The workshop defined a nuclear weapons freeze as an interim measure of two to three years' duration to make clear that it is not intended to freeze the status quo, and that clandestine activities could not cause nuclear disequilibrium.

How you can keep informed

It is difficult to give the full context of the Geneva talks in this short space, though the highlights above give you the key points. If you want to keep abreast of Pugwash meetings, and if you would like to see the names of the participants, you can do so by becoming a *Friend of Pugwash.* As a supporter of Pugwash, you will be entitled to receive reports from all the major workshops and conferences. Thus you will keep current with these important private conferences, and you will also help to make them happen. Pugwash welcomes the help of *Bulletin* readers, and urges you to lend your support. To do so, fill out the coupon below today. All contributions are tax deductible.

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AUG./SEPT. 1984
VOL. 40, NO. 7

Bulletin of the Atomic Scientists

The Bulletin Clock, symbol of the threat of doomsday hovering over humanity, stands at three minutes to midnight.

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On the cover: A close-up view of the miniature U.S. nuclear arsenal of 30,000 warheads, 1,700 missiles, 400 bombers and 33 submarines created by artist Barbara Donachy (shown at left). Displayed in New York City in the fall of 1983, the clay weapons will be shown in Berlin, November 15–December 30. (See "Resource Paper on the U.S. Nuclear Arsenal," pages 1s–16s.)

Cover and page 1s photographs, Dave Perk © 1983; photograph at left, courtesy Nuclear Arsenal Project, 2216 Race Street, Denver, Colorado (80205).

This One
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Sakharov and East-West relations

As we go to press, the shadow of Andrei Sakharov looms ever larger over East-West relations. Critics of the treatment afforded him and his wife, Yelena Bonner, by the Soviet authorities continue to urge that the United States and other Western countries eschew all but the most minimal essential contact with the Soviet Union until the two are allowed to live freely in Moscow and receive independent medical care or to emigrate. In particular, it is argued that relations between American and Soviet scientists should be held to the same standard, since official persecution of so distinguished a scientist for his outspoken political views constitutes an intolerable violation of the principle of intellectual freedom. Should it be proven that Sakharov or Bonner were subjected to direct physical or mental torture, or should either of them die from deliberate medical neglect, proponents of this policy presumably will urge a still further curtailment of relations, and possibly a permanent freeze.

Yet other voices continue to be raised urging patience in the face of the outrages perpetrated against Andrei Sakharov: patience, not silence, and the wisdom to see the higher good of humanity in a nuclear age. One such voice is that of Victor Weisskopf, another distinguished physicist and victim of official, in his case, Nazi, persecution. The following remarks are excerpted from a talk given by Weisskopf in May at the fiftieth convocation of the University in Exile in New York.—The Editors

We certainly should never cease attacking publicly all infringements of freedom of expression, of civil liberties. We should welcome all those who succeed in leaving oppressive countries. They will contribute to our culture just as did the refugees of Nazism.

But I believe strongly that, in contrast to 50 years ago, we must seek all possible contact with the intellectuals in the Soviet Union. We should promote collaboration. We should go to congresses. We should visit their universities and our colleagues over there, both officially and privately. I was very much opposed to the decision of the [U.S.] National Academy of Sciences to break off official relations. Most Soviet scientists are fundamentally in agreement with us; they seek more freedom and secretly condemn many oppressive acts. They are under terrible pressure. They need encouragement and contact. They must not lose the feeling of being part of the world community of intellectuals. They need us to be able to resist the tremendous propaganda, the tremendous brainwashing efforts by their government. They need to hear the other side.

When we go over there we must, of course, express our opposition to the repressions and try to meet and talk to those who are oppressed. Sometimes this is difficult; sometimes it has led to expulsions, but we have to take this risk.

Equally, we should not use the oppressive acts over there to keep Soviet scientists from coming here. We must invite them to collaborate with us and to visit us. Yes, some of them may have connections with their secret police, but most of them are bona fide scientists, and a good many of them sympathize with our view. They should come here. They should see how we live and work, and this again will give them encouragement. Scientists are not so powerless there; some of them have influence on what is going on.

Now there is a factor which makes the situation worse today. The policy of the present U.S. administration fosters a cold war mentality. We move toward military confrontation, toward a policy of military superiority, aiming to rid the world of "evil communism." At the same time, however, we support repressive regimes that happen to be anti-communist. Let us not forget that in the days of nuclear weapons it is impossible to get rid of "evil communism" by force and by military means. Such a policy against Nazism was probably right in 1940; it exacted terrible costs in lives and destruction, but, after all, it succeeded. Today it cannot succeed. A policy that is perceived to be aimed at that goal will increase the fear of Western ideas in the Soviet Union and therefore increase the oppression and persecution of dissidents and it will not lead to any solution. But it may very well lead to Armageddon.

In my view intellectuals should denounce the infraction of civil liberties wherever they see it, but they must build bridges. We must live and let live. This attitude could be called appeasement, but we have no other choice today. We cannot force the Soviet authorities to observe civil rights by threat and cold war. The improvement of human rights in Communist countries will be a very slow process. It will probably take a long period of political detente, of abatement of fear of aggression between the superpowers before we see an improvement in the situation. You cannot change a political structure from outside except by war, and that is out of the question. □

Ruth Young

Rarely do clear thinking, firm but unauthoritarian guidance, unstinting devotion to a job, compassionate intra-office mediation and never failing good humor come together in one individual. All those qualities and more met in Ruth Young, the *Bulletin*'s managing editor for two and a half years. Ruth left the *Bulletin* in May to pursue other interests. We wish her luck, but we shall miss both her professional ability and the warmth of her presence.—The Editors

Arms control priorities for the next Administration

by David Linebaugh

THE NUCLEAR arms race escalates, and tension and suspicion deepen between Washington and Moscow. For the first time in over a decade, there are no nuclear arms negotiations between the United States and the Soviet Union. Prospects for controlling nuclear weapons have never been so remote.

Both superpowers possess vast arsenals of these arms and each could annihilate the other many times over. Yet neither side has initiated a change in direction. This situation must not be allowed to continue. American leadership must propose a way to reverse this trend.

As a first step, the U.S. President and Soviet General Secretary should meet early in 1985. Their dual purpose should be to:

- revive nuclear arms control negotiations in a single forum;
- stop the nuclear arms race by a selective freeze.

This first summit meeting for the two leaders should focus on nuclear issues where there may be common ground: a nuclear war cannot be won and should never be fought; defense against nuclear attack is not possible. Defensive as well as offensive systems should therefore be limited. The Anti-Ballistic Missile Treaty of 1972 should be reaffirmed, and the strategic defense initiative—"Star Wars"—should not be pursued.

The summit meeting should avoid polemics and expositions of conflicting ideologies, seeking rather to reach concrete and practical agreements. It should be prepared by specially appointed representatives who could begin meeting informally shortly after the U.S. presidential election. To revive U.S.-Soviet nuclear negotiations, the two leaders should agree to guidelines for achieving reductions on medium-range weapons, including a moratorium on the deployment of these weapons.

Arms control talks ended when the Soviets walked out of the medium-range missile negotiations on November 23, 1983 and two weeks later opted not to schedule new strategic arms reduction talks. The Soviets left the talks because the United States had begun deploying Pershing II and ground-launched cruise missiles in Western Europe. The Soviets, comparing the situation with the Cuban missile crisis, had warned that these missiles would alter the strategic balance because they could strike the Soviet homeland. The Soviets have said they would return to the bargaining table when Washington indicated a "readiness" to remove the missiles.

Two issues have blocked an agreement on medium-range missiles: Soviet insistence on counting British and French missiles in the Western total and U.S. insistence on American deployments in Western Europe. The Soviet and U.S. leaders could reach a satisfactory agreement by modifying their positions on these issues. The United States could agree to take account of British and French forces because these are targeted on the Soviet Union, and since Britain and France are allies they logically share the burden of Western defense. In return the Soviets should agree to some American deployments of ground-launched cruise missiles.

A moratorium on nuclear tests would retard or even halt development of new weapons.

The deployment of Pershing II missiles, which can strike with virtually no warning, would not be permitted.

If the Soviets agree to renew negotiations based on these guidelines, the United States could propose a single negotiating forum for both strategic and medium-range weapons. The American advantage in strategic warheads then could be used to offset the Soviet advantage in medium-range warheads. Definitional differences about weapons would be resolved, and the Soviet interest in conditioning an intermediate-range nuclear forces (INF) agreement on a START agreement would be met.

The President should inform the Soviet leader that the United States will immediately freeze the testing and deployment of the major weapons that are driving the arms race, with U.S. observance dependent upon reciprocal Soviet observance. Arms restraint would thus be achieved by mutual example, comparable to the restraint exercised by Washington and Moscow on nuclear tests from 1958 to 1961.

Designed to take effect immediately, the freeze would be verified by national technical means. There would be no freeze on production since that would entail the time-consuming negotiation of verification arrangements. Some weapons systems, like aircraft and single-warhead missiles

David Linebaugh is a former deputy assistant director of the U.S. Arms Control and Disarmament Agency and a member of the Committee for National Security in Washington, D.C. (20036). Peter Lavoy, a graduate student at the University of California at Berkeley, helped to prepare the article.

which are not considered so destabilizing, would be excluded.

The weapons to be frozen include:

- multiple warhead intercontinental ballistic missiles (MIRVed ICBMs);
- anti-satellite weapons (ASATs);
- sea-launched cruise missiles (SLCMs);
- explosive devices or nuclear warheads.

MIRVed ICBMs—for example, the American MX and the Soviet SS-X-24— fall dangerously short of meeting the basic requirements for nuclear stability. Stationed in fixed sites, they stand little chance of surviving a first strike, and their multiple warheads and great accuracy enable them to be used in a preemptive counterforce attack. Their deployment would make the nuclear balance less stable and more dangerous.

Anti-satellite weapons would jeopardize early warning of an attack, pose verification problems for an arms control agreement and threaten communication facilities vital to a stable balance free of accident or miscalculation. The Soviets now have a primitive, low-altitude anti-satellite weapon that is easy to detect. The United States is testing a more sophisticated weapon that will be harder to detect. But a moratorium on testing is still verifiable.

Sea-launched cruise missiles, small and easily concealed, are to be used as a "strategic reserve," a purpose that apparently assumes there can be a protracted nuclear war. They are a far more serious threat to the United States, with its long coastlines, than they are to the Soviet Union. Furthermore, these missiles may present difficult verification problems, especially after the Soviet Union acquires them.

A moratorium on nuclear tests—tests of explosive devices —would have far-reaching effects in retarding or even halting the development of new weapons. This major move of restraint by the superpowers would have useful effects on non-proliferation.

WHILE THE FIRST PHASE of renewed Soviet-American arms control could be realized quickly at a summit meeting, the second phase, involving actual arms reduction, a permanent ban on anti-satellite weapons and ballistic missile defense, and a comprehensive test ban, could be more difficult.

The United States should consider two reduction plans. The first would impose reductions on warheads only, while the second would impose reductions on missiles and bombers as well as warheads.

Reduction of warheads only could be negotiated quickly, resulting in a simple one-provision agreement. It could strengthen stability if both sides moved away from multiple-warhead missiles to single-warhead missiles, which are less attractive targets. And this agreement might be welcomed by our allies if it resulted in a shift away from medium-range missiles to more versatile strategic missiles.

The second plan could be based on SALT II, simplifying the negotiations and leaving nothing to chance. For example, an agreement calling for heavy reductions of MIRVed ICBMs—weapons that are both vulnerable and threatening —would insure a strengthening of stability. Establishing a sub-limit on medium-range missiles would also meet the interest of our allies in lessening the threat to Western Europe. It would require substantial Soviet reductions. This plan would have to be detailed and comprehensive, but it would guarantee a positive outcome.

Before the suspension of the Comprehensive Test Ban (CTB) negotiations in 1980, important understandings had been reached: all tests in all environments would be prohibited; on-site inspections would be allowed; and arrangements were agreed to for installing tamper-proof seismic stations by each country in the territory of the other. Many of the most contentious issues had been resolved.

An agreed upon treaty is within reach, and a short moratorium on all nuclear tests should provide enough time to complete the negotiations. Ratification of the threshold test ban and the agreement on peaceful nuclear explosions, which allow tests of yields up to 150 kilotons, would be unnecessary and illogical.

Bold action is needed to halt the nuclear arms race. Defensive as well as offensive systems must be limited. The United States should propose a plan to the Soviet Union which would include a summit meeting, a selective freeze, renewed negotiations, reductions and a comprehensive test ban. These are the priority tasks. □

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Today the United States is not only pursuing a Brezhnev Doctrine of its own, but, driven by a habitual hatred of the Soviet Union and all its works, it is even imitating Soviet methods.

Slaves to animosity

by George W. Ball

ONE OF THE SAGEST admonitions in George Washington's Farewell Address was that we Americans should beware of "inveterate antipathies against particular nations."

"The nation," he said, "that indulges toward another an habitual hatred . . . is in some degrees a slave. It is a slave to its animosity . . . which is sufficient to lead it astray from its duty and its interests." And he added: "Antipathy in one nation against another disposes each more readily to offer insult and injury, to lay hold of slight causes of umbrage, and to be haughty and intractable when accidental or trifling occasions or disputes occur."

That advice has particular relevance today, for our government is exhibiting toward the Soviet Union such an "habitual hatred" as to make it, in Washington's phrase, "to some degrees . . . a slave to its animosity."

No sensible American would, of course, contend that the rivalry that exists between the West and those nations and peoples dominated by Moscow is without substance or that it should be taken lightly. The competition between two great power centers, each armed to the teeth with nuclear weapons, is indubitably a central element of international relations. But it should not become such an all-consuming element as to obscure the other diverse problems that now face us.

The world of the late twentieth century is enormously complex and intricate, and nothing can more seriously throw us off course in conducting international relations than to ignore that fact. Yet our foreign policy today is dominated by a passion for oversimplification, largely because living with complexity is forbiddingly difficult. It requires skill, patience, thought and a spacious view that can be achieved only with a comprehension of history and the application of sustained effort.

The easy, escapist resort is to let our "habitual hatred" of Moscow dictate our policy and to adopt a Manichean view that sees our foreign policy as an eternal struggle between America as the embodiment of righteousness and the Soviet Union as the "focus of evil." That view is heavily influenced by the movies, which base many story lines on an inevitable shoot-out between the good guys and the bad guys, the black hats and the white hats. But that is the fantasy of scriptwriters, who can always assure that right prevails and that the ending is happy. In real life there are an appalling number of subplots, while motivations and emotions are so much conditioned by history and geography—by political and economic disparities; ethnic, religious, tribal and family disputes and differences—as not to permit substituting a comforting dichotomy for complex analysis and hard decisions.

Thus we are stultifying ourselves when we base our policy on President Reagan's expressed assumption that, if the Soviet Union did not exist, the world could live in relative tranquility without "hot spots." The facts emphatically deny this. During the whole of the past decade, the developments that have most critically jeopardized and harmed Western interests have resulted from movements, actions and policies with which Moscow has had nothing to do.

OPEC's precipitate price increases dislocated the world's economy and helped bring about a global recession. That was an initiative not of the Politburo but of a group of Third World nations exploiting their monopoly of a key source of the world's energy. Nor did the Soviets overthrow the shah of Iran. He was pushed off his throne not by external forces, but because he had, from good motives and bad, managed to alienate almost every sector of Iranian society. Even the most paranoid ideologues cannot blame Moscow for the Iran-Iraq war. Nor is Moscow in any way the cause of the festering Arab-Israeli struggle, or the agonies of Lebanon, the communal bloodshed in India, the menacing racial tensions in South Africa, the religious feuding in Northern Ireland, the quarrel between the Moroccans and the Polisario in North Africa, Libya's threat to the Sudan, the comic opera conflict in the Falklands—or any of numerous other "hot spots," as the President calls them.

So we make a caricature of foreign policy when we let our "habitual hatred" of the Soviet Union becloud our sense of the complexity of the world predicament. Most troubles between nations are local or regional in nature. More than 40 shooting wars are now in progress around the globe, and all but a tiny number result from ethnic or religious conflicts, racial animosities, intolerance and repression in all its forms, inequities and inequalities, ancient boundary disputes, and historic arguments that are not less bitter for having lost all discernible relevance to today's realities. The reaction of our government, almost by conditioned reflex,

George W. Ball was undersecretary of state from 1961 to 1966 and permanent representative to the United Nations in 1968. His book on U.S. policy in the Middle East, The Passionate Attachment, *will be published next year.*

to force everything into the oversimplified mold of the East-West struggle—to bend and push and pull and distort parochial disputes to fit the doctrinaire concept of the polarized conflict known as the Cold War—is not only factually dishonest but a fatuous delusion.

Not the least of the dangers in such a foolish exercise is that it could prove self-fulfilling. If we insist that long-running, complex, factional feuds are intricately related to the quarrel between the United States and the Soviet Union as the "source of all evil," we shall go on repeating the error of Vietnam, where we confused a combination of Tonkinese imperialism and civil war having anti-colonialist overtones with a deliberate aggression by the major Communist powers. And we shall go on producing humiliating fiascos such as that we suffered in Lebanon, where we sought to justify our own careless involvement in an environment of long-standing factional conflict by portraying Syria as a mere Soviet puppet. We shall pay heavily for the damage and dislocations we mindlessly encourage.

WASHINGTON PRESCIENTLY anticipated current developments when he told us that an habitual hatred can lead to slavery. Not only are we exhibiting an aspect of slave mentality by imitating the Soviets; we are also validating an old French adage that we acquire the visage of our adversary. In our obsession with the Soviet Union, we are adopting its principles and aping its practices—and diminishing our country in the process.

Consider, for example, our conduct in Central America and the Caribbean. In 1968, when the Kremlin moved its army into Prague, the Soviets sought to justify that action by the so-called Brezhnev Doctrine, which holds that Moscow is entitled to interfere in the affairs of any socialist state within its sphere of influence if that state shows signs of succumbing to Western ideas. Today our government, without admitting it, is pursuing its own particular form of the Brezhnev Doctrine.

How do we justify trying to overthrow the government of Nicaragua? The people of that country, so our leaders say, have been captured by a political and economic system that is anathema to us. Moreover—and this is quite unforgiveable—the Nicaraguan government draws support from Cuba and the Soviet Union. Since we have historically, if never explicitly, regarded Nicaragua as within our sphere of influence, we claim the right to overthrow its government and install one more to our liking. Of course that is not the public rationale. Our government is visibly working with and supplying arms, money, training and ammunition to the "contras"—Nicaraguan emigrés, including ex-Somoza followers—whose sole objective is to overthrow the Nicaraguan government and take over themselves. Yet the Administration insists that it might abandon the contras—"betray" is the harsher term—if the Sandinista government would only stop shipping arms to the Salvadoran rebels. But even if that is really our position, does it justify our intervention? Are we entitled to claim the right to export our revolution to Nicaragua and overthrow its government solely to prevent Nicaragua from exporting its revolution to Salvador and trying to overthrow its government?

If we are honest with ourselves, we will recognize that our assumed right to depose (or, to use the euphemism, "destabilize") distasteful Latin American governments is merely

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an atavistic manifestation of gunboat diplomacy. Although we now claim to have outgrown that practice, we still pursue it and, in the process, leave the people of target countries in worse condition than before:

- As far back as the 1920s, when we sent our Marines for the second time to Nicaragua because its government was, we claimed, falling under Bolshevik influence from Mexico, we saddled that country with the Somoza regime which repressed the people and bled them white for the next four decades.
- When, under the Eisenhower Administration, we overthrew the duly-elected Arbenz government in Guatemala, we bequeathed that country a succession of military juntas punctuated by assassination.
- When we sought in the early 1970s to overthrow the Allende government in Chile before it overthrew itself by its own incompetence, that nation fell under the Pinochet regime, which has set an odious mark for brutality.
- Finally, when we launched the Bay of Pigs operation to try to depose Castro, we succeeded only in establishing his control of Cuba more firmly than ever.

TODAY WE ARE NOT ONLY pursuing a Brezhnev Doctrine of our own, but, driven by our habitual hatred of the Soviet Union and all its works, we are even imitating Soviet methods. There is no way we can reconcile our avowed national principles with such outrageous conduct as mining harbors and interrupting international traffic into Nicaragua—a clear act of war against a government with which we maintain formal diplomatic relations. We are behaving even more odiously when we reject the arbitrament of the World Court—again an action slavishly imitating the nation we habitually hate.

Of course, our government defends such unworthy activities by the banal casuistry with which evil has been justified since time immemorial. It is the argument of last resort by every schoolboy caught with a slingshot in his pocket: We have to use such tactics because other kids use them.

Such a rationale for aping Soviet methods is not only contemptible but stupid. The Soviets can use covert tactics far better than we can because their system is cursed with the very qualities we most scorn, including a Byzantine addiction to secrecy. America's commitment to an open society, on the other hand, disqualifies us from competing in that league. The conclusion that emerges from all this is that no nation can act effectively when it is violating its own principles and traditions.

That, however, is only one of the reasons why we should avoid such squalid tactics. By resorting to them we squander our most valuable advantage as a democratic state—our reputation for freedom, honesty and decency—which clearly sets us apart from the Soviet Union. That nation faces a dreary future. Its system simply is not working. The Soviet standard of living is miserable and scarcely improving. Soviet leaders face a serious struggle even to keep their vast country together, for the Russian element in the population is about to become a minority, and ethnic unrest poses critical problems. Meanwhile, the Eastern European nations that form the balance of COMECON (Council for Mutual Economic Assistance) grow progressively more discontented, as is underlined by the current agonies of Poland.

Not only do the Soviets face deep troubles within their empire but their system also has largely lost its appeal in the Third World. Initially, many leaders of the nations that emerged from the ruins of the great colonial empires were attracted by the Soviet model—influenced in part by their desire to show their independence of the Western powers that had kept them in colonial status. But the Soviet model has now lost its glamour.

Wiser American policy would fully exploit our inherent advantages. We have a system that works and has given us unparalleled economic power. In addition, we possess a great potential asset in the appeal of our nation to the new generations of Third World leaders just now moving into positions of power and authority. But to benefit from that asset we must validate it in practice, and that means acting in accord with our principles and not behaving like an international thug. We must be true to our own avowed principles, respecting the sovereignty of countries no matter how small, supporting and trying to advance human rights and showing by our actions as well as our words that we are firm in our commitment to freedom and diversity. We must make clear that we are not ideologues doctrinally committed to fixed patterns of life and structure, but respect the right of any nation to adopt whatever system it may prefer even though we think it is making a mistake.

We must, in other words, act in character, displaying the qualities of tolerance and understanding which have inspired other nations from our earliest days as a republic. America still has a large residue of respect and confidence remaining all over the world, even though in the last 20 years we have recklessly depleted it.

Throughout the Third World many young men and women are still singing our songs rather than the Internationale and are still quoting Thomas Jefferson more than Felix Dzerzhinsky. The shot heard round the world is still loudly and effectively ricocheting. So let us by all means reconsider what I fear we are now doing—trying to combat the communist powers on their own level and with their own instruments.

Let us avoid being led by our habitual hatred for the Soviet Union to imitate its practices. And finally, let us avoid the seductive glibness of oversimplification. We live in a complex world and we shall succeed only if we acknowledge that fact and shape our plans and meet our obligations in those terms. □

The threat of a nuclear winter and the need to defend Western Europe lead the author to urge a radical reduction in the number of nuclear weapons and a strengthened conventional defense.

Are nuclear weapons obsolete?

by Bernard Weissbourd

THE MOMENTUM of the arms race has been carrying us steadily, inexorably, toward the acceptance of nuclear weapons as useful tools of war. Improvements in missile accuracy have given rise to the fear—and, in some quarters, the hope—that these weapons have become just that, *weapons*, devices that can be used to achieve military objectives other than deterring their use by others. The arms race has thus come to follow a perverse logic: each side seeks to insure deterrence by developing warfighting capabilities which by their nature threaten deterrence.

Animated by fear, this trend is, ironically, sustained by an illusion of control: the illusion that nuclear weapons can be used in limited, calculable, predictable ways. In view of what we know—and, more important, do not know—about the effects of nuclear war, this illusion is impossible to maintain.

A stunning demonstration of this is provided by recent studies of the possibility that a nuclear war might precipitate a climatic catastrophe—a "nuclear winter." These studies deepen our awareness of how precarious our situation is. They force us to recognize the extent of our ignorance about the effects of nuclear war. They powerfully reinforce arguments for massive reductions in the world's nuclear arsenals. And, as I will argue below, they make providing an adequate conventional defense of Europe a matter of the utmost urgency. In short, far from becoming useful and usable, nuclear weapons are becoming obsolete. The central goal of defense policy should be to hasten their obsolescence.

The "nuclear winter" findings have been reported in the April 1984 *Bulletin* and elsewhere.[1] Briefly, they indicate that even a relatively small nuclear exchange might result in the extinction of the human species due to a factor earlier studies neglected to consider—the dense clouds of soil particles and the smoke from fires that would be generated by nuclear explosions. Beyond a certain threshold, nuclear dust and smoke would largely block out sunlight for months, perturbing the Earth's climate. Temperatures would fall. Crops would fail. Ecological systems would be disrupted. Radiation would be several times more intense than previously estimated. When the soot and smoke clouds lifted, ultraviolet rays from the sun could reach unbearable levels because of ozone loss. And there might be still worse synergistic effects not yet identified. As a result of these developments, the human population "conceivably could be reduced to prehistoric levels or below, and extinction of the human species itself cannot be excluded."[2]

The precise threshold beyond which a climatic catastrophe would occur cannot be fixed with any certainty. But it appears to be extremely low relative to the 12,000 megatons of yield in the world's nuclear arsenals. Carl Sagan offers this estimate of the number of nuclear explosions beyond which a nuclear winter would occur:

> There is an indication of a very rough threshold at which severe climatic consequences are triggered—around a few hundred nuclear explosions over cities, for smoke generation, or around 2,000 to 3,000 high-yield surface bursts at, e.g., missile silos, for dust generation and ancillary fires.[3]

The single most startling finding in Sagan's report is that a 100-megaton exchange, causing the centers of 100 major NATO and Warsaw Pact cities to burn, could bring on a nuclear winter. In other words, even a relatively small and contained nuclear war—one employing less than one percent of the world's nuclear arsenals—could threaten the survival of the human species.

These findings are necessarily hypothetical. They are based upon various models, simulations, scenarios and projections. While the conclusions of the report have been endorsed by a large number of American scientists, and the findings have been confirmed by Soviet scientists, some of the assumptions used have been challenged. It is important to recognize, however, that the ultimate significance of these studies resides not only in their contribution to our knowledge of the effects of nuclear war but also in the sharp reminder they provide of how incomplete that knowledge is. Ironically, they improve our perspective by enlarging our uncertainty; they extend our knowledge by forcing us to recognize how little we know. It is chastening to realize that policies and strategies upon which the fate of the world hangs have been formulated in ignorance of the possibility of the nuclear winter phenomenon. And it is only prudent,

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in light of the evidence amassed thus far and in view of what is at stake, to assume the worst case, pending further investigation.

Once political leaders become aware of the risk of climatic catastrophe due to a nuclear exchange, we will be safer than we are now. In general, the nuclear winter findings strengthen deterrence. More specifically, they render obsolete scenarios for "winning" a limited nuclear war through a counterforce attack. For an effective counterforce strike by either superpower would require several thousand warheads, enough to trigger a nuclear winter. No rational leader would contemplate such an attack, knowing it would mean suicide for his own country, *even if there were no retaliation.*

Nations do not, however, always have rational leadership. And a nuclear war may start by miscalculation or accident as well as by design. The only way to be sure that humanity will not be extinguished in the event of a nuclear war is to keep the tonnage of nuclear weapons in the world well below the threshold beyond which a climatic catastrophe may occur. It is thus imperative that we work toward reducing the world's nuclear arsenals by more than 99 percent.

This is an ambitious goal. Where should we start? Where might we most productively invest our efforts? I believe that the crucial first step is to provide an adequate conventional defense of Europe. Such a course would ease the great dangers inherent in present NATO policies. It would eliminate a major stimulus to the arms race: the U.S. effort to compensate for NATO's conventional inferiority by seeking nuclear superiority. And it would help to create the conditions for achieving massive reductions of nuclear weapons.

Our present policy seeks to remedy NATO's conventional inferiority by threatening the first use of nuclear weapons in the event of a conventional attack. In view of the risk of uncontrollable escalation threatened by any use of nuclear weapons, this policy is at once unworkable and reckless. In view of the possibility that a relatively small nuclear war in Europe, even if it remained "limited," might produce a climatic catastrophe that would extinguish the human species, it is intolerable.

The present NATO policy of "flexible response" is *designed* to bring about escalation to the use of nuclear weapons. Because of the perception that NATO's conventional defense is inadequate, we installed tactical nuclear weapons in Europe. Because some of our allies believe that there is a "gap" between our tactical nuclear weapons and our strategic ones, we are now deploying intermediate weapons—Pershing II and cruise missiles—in Europe. We have thus constructed an "escalation ladder" to assure our allies that our strategic arsenal will indeed be used in the event of a conventional attack.

In order to escape from the perverse logic of this policy, we must correct the asymmetry at the bottom of the escalation ladder: we must, in short, provide an adequate conventional defense of Europe. There is, in fact, growing support for this course of action. Cost need not be an insurmountable barrier. And the nuclear winter findings should help make clear to all that there is no sensible alternative.

WHAT IS AN ADEQUATE conventional defense of Europe? There are several relevant considerations:

- The Soviet Union cannot win a war of attrition against the Allies because of our industrial superiority. In World Wars I and II this superiority proved decisive.
- The measure of an adequate conventional defense is not that it be certain to succeed in any possible circumstances. Rather, an adequate defense is one that will stop a blitzkrieg. If a would-be attacker perceives that a blitzkrieg is likely to fail and to evolve into a war of attrition, he will be deterred from initiating hostilities.[4]
- Adequacy does not mean equality. Adequate NATO conventional forces, even if less than equal, can stop a Soviet offensive, since more troops are required for offense than defense. Morever, new precision-guided munitions give an added advantage to the defense.

The ability to turn any conventional attack into a war of attrition is a more credible deterrent than the threat of using nuclear weapons under circumstances of nuclear parity. At present the lack of an adequate conventional defense leads the United States to threaten the first use of nuclear weapons as a means of deterring a conventional attack. If NATO had an adequate conventional defense, then conventional war would be deterred and the situation would be reversed. NATO's sole need for nuclear weapons would then be to deter a first use of nuclear weapons by others.

I do not call for a pledge of no-first-use but rather for creation of the conditions that would make a *policy* of no-first-use possible. Such a policy would be reflected in the types of weapons developed and deployed, their location, the training of troops and so on. A policy of this sort would make a real difference, while a pledge, in the absence of such a policy, might be broken by a superpower with "its back to the wall."

THERE ARE TWO WAYS in which an adequate conventional defense of Europe can be achieved: by negotiation or by strengthening NATO's conventional capabilities. The former course is obviously preferable: we are far more likely to achieve true security by negotiating a balance at a lower level than by building up to a balance at a higher level. Moreover, successful negotiations would nurture mutual confidence and help create the conditions for realizing our ultimate goal of massive reductions in nuclear arsenals.

The chief avenue for pursuing a negotiated balance in conventional forces is the Mutual and Balanced Force Reduction (MBFR) talks in Vienna. The objective of these negotiations is to reduce the forces on each side in Central Europe below the levels required for a successful offensive. Initiated 12 years ago, they have thus far yielded little. But the obstacles to progress do not seem insurmountable, and

the potential benefits of an agreement are great. The MBFR talks should thus be vigorously pursued.

They should also be expanded to include the objective of eliminating tactical nuclear weapons in Europe. In view of the close relationship between achieving conventional adequacy and reducing reliance on tactical nuclear weapons, negotiations in these areas should be combined. Were agreement reached on force reductions, there would be a strong incentive to remove tactical weapons. For under circumstances of conventional parity the great danger posed by these weapons would clearly outweigh any possible benefit.

Another important and complementary objective for negotiation is the establishment of a nuclear-weapons-free zone on either side of the East-West border in Central Europe. Such a zone would significantly lessen the danger of nuclear war in Europe by reducing the pressures to use nuclear weapons early in a conflict—pressures currently arising from the "use them or lose them" posture of NATO's tactical nuclear weapons.[5]

Serious consideration should be given to taking the initiative by withdrawing NATO's tactical nuclear weapons to the rear. Such a move could help create a positive climate for negotiations and might elicit reciprocal moves on the part of the Soviet Union. In any case, it would be in our interest, for there is little doubt that these weapons, as presently deployed, pose more of a threat to NATO than to the Warsaw Pact.

IN THE ABSENCE of successful negotiations, NATO must strengthen its conventional defenses. There is resistance to this course of action for several reasons: cost, political obstacles within the Alliance and the risk of provoking a conventional arms race. Yet if negotiations fail, there is no alternative; the dangers that attend our present course are intolerable. Conventional modernization has the potential to reduce those dangers. It also has the potential to compound them. So we must proceed with great care and clarity of purpose.

An important element in the effort to strengthen NATO's conventional defenses will be a rapidly advancing area of military technology known as "precision-guided munitions" (PGMs) which promise to shift the technological advantage away from offense and toward defense. Spawned by the computer revolution, PGMs are small missiles, equipped with conventional warheads, which are designed to destroy large targets such as tanks, planes and ships. Their effectiveness is a product of their accuracy; equipped with sophisticated guidance systems, they have a high probability of striking their targets. There are various weapons in this category—ranging from devices small enough to be shoulder-launched by a single infantryman to long-range cruise missiles capable of striking targets deep in enemy territory.

The essential feature of PGMs is that they make attack more difficult and defense easier. Light, mobile and relatively cheap, they render large, powerful, expensive vehicles —such as tanks—vulnerable. And they make the individual soldier far more valuable. In the past anti-tank weapons were of limited value and armored columns could virtually ignore pockets of infantry. Now anti-tank PGMs must be suppressed before the tank advances. Moreover, the increased firepower available to the individual soldier reduces the size of the force required to hold a front, thereby releasing troops for use in a strategic reserve or for deployment as part of a defense in depth.[6]

Economical and effective, PGMs thus hold great promise —the promise of helping to render tactical and theater nuclear weapons obsolete. They will undoubtedly be an important ingredient in any recipe for an adequate conventional defense of Europe. Their promise is not, however, without attendant difficulties and risks. For one thing, there is an open question as to the effectiveness of countermeasures now being developed to increase the survivability of tanks and aircraft against PGMs. There are also difficult questions regarding how best to orchestrate the transition from a defense relying on nuclear weapons to a defense relying on PGMs. The most troubling of these have to do with long-range, as opposed to battlefield, PGMs—specifically with missiles like the cruise which strategists contemplate using for deep strikes against enemy assets necessary for a successful blitzkrieg.

Some have argued against this strategy on the ground that it would create pressures for a Soviet preemptive strike early in a conflict and so would lower rather than raise the nuclear threshold. This argument fails to take into account one of the distinguishing characteristics of cruise missiles: their small size and mobility make them undetectable. While this feature makes them difficult, if not impossible, to subject to effective arms control, it also has the potential to contribute to crisis stability. For how can you preempt that which you cannot locate? It should thus be possible to deploy cruise missiles armed with conventional warheads in a manner that reinforces conventional deterrence without offering provocative targets for preemption.

A more serious problem is posed by the fact that these missiles can be used to deliver both nuclear and conventional warheads. A situation in which each side is armed with missiles, some of which have nuclear and some conventional warheads, is confusing and dangerous, for it is difficult to tell whether an incoming missile is conventional or nuclear. Thus a purely conventional attack against non-nuclear targets might trigger a nuclear response.

This is the chief difficulty with proposals for raising the nuclear threshold in Europe by strengthening NATO's conventional defenses by means of PGMs, while continuing to rely on nuclear weapons. One of the best known such proposals is that of General Bernard Rogers, currently the Supreme Allied Commander in Europe.[7] He argues that for a modest additional expenditure NATO could achieve an adequate conventional capacity by the end of the decade. Specifically, he would bring current forces up to peacetime standards, improve electronic sensor systems which can

look deep into the aggressor's territory, improve information and control functions, and make heavy use of both battlefield and long-range PGMs. His use of these weapons, as I understand it, would not be governed by the objective of eliminating nuclear weapons but rather of supplementing them. This could result in a situation that is more, rather than less, dangerous, because a conventional attack might be mistaken for a nuclear attack.

A plan such as General Rogers's which makes heavy use of PGMs while continuing to rely on nuclear weapons, would, according to one study, cost roughly $20 billion over several years.[8] By contrast, the cost of providing an adequate NATO defense without relying on tactical or theater nuclear weapons has been estimated at $100 billion over six years, or $16–17 billion per year.[9] My argument accepts the latter figure. There is no way around the fact that a conventional defense of Europe that does not ultimately rely on nuclear weapons will cost more. But it will also purchase more: a conventional deterrent to conventional war which will not increase the risk of nuclear war.

SUCH AN APPROACH to NATO's security predicament is technically and financially feasible. Is it also politically feasible?

The United States' guarantee to defend Western Europe against an attack with conventional weapons by the Soviet Union was given at a time when we had a monopoly on nuclear weapons. Under present conditions of nuclear parity the credibility of that guarantee has been undermined. As Lawrence Freedman has observed, the doctrine of flexible response involves an inadequate conventional defense backed by an incredible nuclear guarantee. The real value of the doctrine, he argues, is that it serves as a basis for an alliance consensus, but "its prime political attribute—that it can mean all things to all men—is a serious military failing."[10]

Consider the dilemmas this state of affairs gives rise to. Not only is it hard for the United States to make its strategic guarantee seem ironclad, but, as David Schwartz has observed, its efforts to do so give rise to "the opposite fear within the alliance, namely, that the United States could commit its allies to a nuclear war they neither want" nor, given their vulnerability to Soviet nuclear attack, could survive. This fundamental dilemma "forces the United States to walk a thin line between European fear that the American strategic arsenal does not afford protection and fear that it does, with potentially suicidal consequences."[11]

In September 1979 Henry Kissinger put the point bluntly. "The secret dream of every European," he told an audience in Brussels, "was, of course, to avoid a nuclear war but, secondly, if there had to be a nuclear war, to have it conducted over their heads by the strategic forces of the United States and the Soviet Union."[12]

The Cold and the Dark of Nuclear Winter

Recent scientific findings made public at the Conference on the World After Nuclear War (Oct. 31-Nov. 1, 1983) suggest that nuclear war could generate vast clouds of soot and dust that could envelop and transform the Earth into a darkened, frozen planet for weeks or months, thus threatening the very survival of many species, including humankind.

According to Lewis Thomas, these scientific discoveries "... may turn out ... to have been the most important research findings in the long history of science ... (These findings) change everything in the world about the prospect of nuclear war."

As the successor to the Conference on the World After Nuclear War, the Center on the Consequences of Nuclear War cooperates with other organizations and disseminates information on nuclear winter.



Nuclear winter would bring a pall of darkness and sub-freezing temperatures. Illustration, Rob Wood, Stansbury, Romsaville, Wood, Inc., 1983. From slide series.

Nuclear Winter Information Materials Available

For an order form and further information, write to the Center.

- **6-minute videotape/film,** a striking depiction nuclear winter, seen from space and on Earth; photos, artwork, animation. Narration: Carl Sagan.
- **Documentary videotape** (28 minutes) on the Moscow Link, a satellite teleconference between US and USSR scientists. Narrator/host: Carl Sagan.
- **Color slides with captions** depicting biological consequences of nuclear winter.
- ***The Cold and the Dark,*** hardcover book (W. W. Norton and Co., Inc., 1984). Authors: Paul R. Ehrlich, Carl Sagan, Donald Kennedy, Walter Orr Roberts. Includes proceedings of Conference on the World After Nuclear War, 4-color illustrations, etc.
- ***Science* reprints** of the two key scientific papers on nuclear winter and its biological effects.
- **Information brochure** with color illustrations, and order form for information materials.

 Under preparation: slide show, filmstrip, speaker's kit, photo exhibit.

Center on the Consequences of Nuclear War
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That is a characterization of the European position from an American perspective. The European perspective is that a conventional war fought by the superpowers on European soil would devastate their countries. What deters such a war, they believe, is precisely the threat of nuclear catastrophe. While Kissinger may have overstated the case, the conflict between the desire of Europeans to avoid a conventional war on their soil and the desire of Americans to avoid a nuclear war involving targets in the United States remains unresolved.

Perhaps the nuclear winter findings—and the recognition they force upon us of how little we know about the effects of nuclear war—will make a difference. They introduce a new factor: a war "fought over their heads" between the United States and the Soviet Union could create a nuclear winter that would destroy human life in Europe as well. The NATO policy of flexible response has built a doomsday machine which may be triggered by miscalculation, accident or irrational behavior. Surely it is now as apparent from a European perspective as it is from an American that there are better ways to deter conventional war.

IT IS OFTEN CLAIMED that the chief threat to Western Europe is not armed attack by the forces of the Warsaw Pact but rather political intimidation and economic coercion. General Rogers is among those who have made this argument. The Soviet Union, he says, "does not want war, but she [*sic*] does wish to expand her influence in areas where lack of resistance permits. Her objective for Western Europe is to dominate it without having to fire a shot."[13]

Regardless of Soviet intentions, an adequate conventional defense will deter intimidation as well as war. But there is a larger point.

After World War II we were concerned that the Communist Parties in several West European countries would come to power. Since we believed these groups were subservient to the Soviet Union, we feared that the Soviet Union would dominate Europe through its "puppets." Today with much weaker Communist Parties in Western Europe, many of which are anti-Soviet, we fear "intimidation." Most Europeans would reject this view. The point is that where fear is mobilized, it does not matter whether a particular perceived threat is correct or not. If one such view is refuted, scenario writers will create another.

Much of the debate over nuclear weapons policy is based upon illustrations that are highly improbable, such as Albert Wohlstetter's example of a Soviet use of nuclear weapons against military targets in the course of an attack against the northernmost counties of Norway.[14] Other illustrations are only slightly more realistic. For example, it is said that an uprising in Eastern Europe that is getting out of control, or a U.S.-Soviet clash in Iran, or conflict in the Middle East may tempt the Soviet Union to gamble and try to end what they see as a great threat to their security. And so on.

We expect military strategists to practice a prudent vigilance. But too often the exercise of their proper role elides into a narrow, blinkered sort of vision that proves, in practice, to be anything but prudent. Indeed, there is a sense in which the single greatest threat to deterrence may be the strategic mindset that focuses narrowly on threats to deterrence. Seeking to anticipate and counter every conceivable situation in which deterrence might break down, this orientation has all too often generated the very dangers it seeks to prevent. We are captives of the flawed logic that issues from the premise: "if deterrence fails. . . ." Again and again we have pursued security by means that have brought us only insecurity; again and again we have sought to reinforce deterrence by means that have undermined it. Surely we have now had enough experience with this pattern to recognize its futility.

There is another way. It proceeds from the premise that *deterrence must not fail*. And it is animated by the knowledge that there can be no real security so long as nuclear weapons exist in such numbers. Its ultimate objective, I repeat, is to reduce the world's nuclear arsenals by more than 99 percent; and its immediate priority is to provide an adequate conventional defense of Europe.

Under this approach, if security is established, it will be primarily a political, not a military, achievement. It will be a matter of working through differences of perspective—within the United States, with our allies and, ultimately, with the Soviets—toward policies and agreements that serve our profound common interest in survival. This approach is not without risks, but seen in the light of what we do and do not know about the effects of nuclear war, those risks pale beside the risks that daily attend our present course. □

1. R.P. Turco *et al.*, "Nuclear Winter: Global Consequences of Multiple Nuclear Explosions," *Science* (Dec. 23, 1983), p. 1,283; Nuclear Freeze Foundation, "The World Wide Consequences of Nuclear War, Transcript of Kennedy-Hatfield Joint American-Soviet Scientific Forum on Nuclear War" (Dec. 8, 1983).

2. Paul Ehrlich *et al.*, "Long-Term Biological Consequences of Nuclear War," *Science* (Dec. 23, 1983), p. 1,293.

3. Carl Sagan, "Nuclear War and Climatic Catastrophe: Some Policy Implications," *Foreign Affairs* (Winter, 1983/84), p. 267.

4. John Mearsheimer, *Conventional Deterrence* (Ithaca, New York: Cornell University Press, 1983).

5. Independent Commission on Disarmament and Security Issues, *Common Security: A Programme for Disarmament* (London: Pan Books, 1982).

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7. Bernard Rogers, *Manchester Guardian* (Oct. 2, 1983), p. 9.

8. Report of the European Security Study, *Strengthening Conventional Deterrence in Europe* (New York: St. Martins, 1983).

9. Kurt Gottfried *et al.*, "'No First Use' of Nuclear Weapons," *Scientific American* (March 1984), p. 33. This figure, it should be noted, is less than France, Britain and the United States are now spending on nuclear weapons—weapons rendered obsolete by the findings on nuclear winter.

10. Lawrence Freedman, "NATO Myths," *Foreign Policy*, 45 (Winter 1981–82), p. 16.

11. David Schwartz, *NATO's Nuclear Dilemmas* (Washington, D.C.: The Brookings Institution, 1983), p. 3.

12. *Ibid.*, p. 234.

13. Rogers, *loc cit.*

14. Albert Wohlstetter, "Bishops, Statesmen, and Other Strategists on the Bombing of Innocents," *Commentary* (June 1983), p. 30.

QUIZ YOURSELF:

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For Surprising Answers Read ENVIRONMENTAL ACTION

From activism to apathy: America and the nuclear issue, 1963–1980

Like the Bulletin *itself, which will mark its fortieth anniversary next year, the nuclear age has lasted long enough to begin to acquire a history. Readers will remember two recent contributions by historians: Barton J. Bernstein's "Truman and the H-bomb," in the March 1984* Bulletin, *and Allan M. Winkler's "A 40-year History of Civil Defense," in the June/July 1984 issue. On the principle that those who remain ignorant of the mistakes of the past are condemned to repeat them, we intend to publish more historical articles in the months and years to come.*

In this issue, Paul Boyer surveys and analyzes the drastic shift in the American public's concern with the nuclear issue between the Kennedy years and the advent of the Reagan Administration. During this period, he reports, most Americans seemed oblivious to what many people in earlier years, and most people now, consider the greatest danger ever to confront the nation.—The Editors

by Paul Boyer

WRITING IN 1981, George F. Kennan described Americans' response to the threat of nuclear war: "We have gone on piling weapon upon weapon, missile upon missile, new levels of destructiveness upon old ones. We have done this helplessly, almost involuntarily, like the victims of some sort of hypnotism, like men in a dream, like lemmings headed for the sea."

Kennan's generalization is not wholly accurate. Americans have *not* always behaved like lemmings in confronting the nuclear danger. Their engagement with this threat has gone through several distinct cycles of activism and apparent passivity. When applied to the years from 1963 to the later 1970s, however, Kennan's observations seem chillingly accurate. In these years, public involvement with the nuclear-weapons issue sank to a low level indeed.

In exploring this interval, our starting point is September 24, 1963, when the Senate overwhelmingly approved the Partial Nuclear Test-Ban Treaty agreed upon earlier in Moscow. Along with Senate approval, the Treaty won enthusiastic public and journalistic support. Wrote David Lawrence of the conservative *U.S. News and World Report:* "There's a new word in the vocabulary of the day—or at least a more noticeable use of an old word—*euphoria*." Even I.F. Stone, a skeptical, left-wing Washington journalist not given to flights of easy enthusiasm, wrote: "Peace has broken out, and hope leaps up again." The agreement did not halt *all* tests; underground nuclear explosions were still permitted. Nevertheless, it was welcomed as the beginning of a process that would ultimately free the world of the nuclear menace. Summing up the prevailing view, the *New York Times* hailed the agreement in a front-page banner headline as a "Major Step Toward Easing Tension."

Underlying this collective sigh of relief was the fact that for more than a decade the nation had been gripped by profound nuclear fears. America's atomic monopoly ended in 1949, and in the 1950s the United States and the Soviet Union developed the hydrogen bomb, ICBMs and sophisticated control systems that raised the specter of a push-button war which could snuff out millions of lives in the twinkling of an eye.

Feeding the nuclear anxieties of these years was a heavy official emphasis on civil defense (see the *Bulletin*, June/July 1984). Under the "Operation Alert" program of the Federal Civil Defense Administration, evacuation plans, radio alert systems, warning sirens, school air-raid drills and films on how to survive a nuclear attack became familiar features of American life.

In May 1961, shortly before the Vienna summit conference, President Kennedy went on television to urge a national shelter program. A few weeks later, during a period of East-West confrontation over Berlin, Kennedy delivered an even more alarmist speech on the danger of nuclear war and the urgent necessity of civil-defense preparation. Responding to a deluge of panicky requests, the Administration hastily prepared a civil-defense booklet and distributed 35 million copies through schools, post offices and newspaper supplements. The Cuban missile crisis added a grim immediacy to these fears. For a few days in October 1962, Kennedy's warnings seemed about to become reality.

Further, these were years shadowed by fears of nuclear testing. The first U.S. hydrogen-bomb test in 1952 produced unexpectedly high radiation levels. The 1954 test series spread radioactive ash over 7,000 square miles of the Pacific and brought illness and death to Japanese fishermen 80 miles away. Soviet hydrogen-bomb tests, begun in 1954 and continued through the decade, further contaminated the atmosphere. In 1955, radioactive rain fell on Chicago. In 1959, deadly strontium-90 began to show up in milk. A two-part *Saturday Evening Post* feature that year was titled "Fallout: The Silent Killer." Linus Pauling, Barry Commoner and other scientists warned of leukemia, bone cancer and

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long-term genetic damage from nuclear testing. A full-blown fallout scare gripped the nation.

These fears gave rise to a campaign against nuclear testing. Adlai Stevenson raised the issue in the 1956 presidential campaign. Soon it was taken up by such groups as Leo Szilard's Council for a Livable World, Dr. Bernard Lown's Physicians for Social Responsibility and the Student Peace Union. Formed in Chicago in 1959, the Student Peace Union's national conventions attracted hundreds of delegates over the next few years.

ABOVE ALL, there was SANE, the National Committee for a Sane Nuclear Policy. SANE was conceived in 1957 by several veteran peace activists who persuaded Norman Cousins of the *Saturday Review* and Clarence Pickett of the American Friends Service Committee to serve as co-chairmen. With an imposing list of public figures and celebrities as sponsors, SANE announced itself in November 1957 with a large *New York Times* advertisement which proclaimed: "We Are Facing a Danger Unlike Any Danger That Has Ever Existed."

A high point of SANE activism came in May 1960 when thousands attended a SANE-sponsored rally in New York's Madison Square Garden to hear speakers ranging from Republican Alfred M. Landon to socialist Norman Thomas call for an end to the nuclear-arms race. After the rally, 5,000 people accompanied Thomas on a march to the United Nations. The organized test-ban campaign unquestionably intensified public opposition to testing, though the level of opposition was also influenced by U.S.-Soviet relations, diminishing at times of heightened tension, surging upward when tension eased. By late 1959, 77 percent of Americans favored a continuation of the temporary moratorium on nuclear testing then in effect.

Nuclear fear became a shaping cultural force. Books, essays, symposia and conferences explored the medical, psychological and ethical implications of atomic weapons. Novels like *On the Beach, Fail-Safe*, Dexter Masters's *The Accident* and Walter Miller, Jr.'s *A Canticle for Leibowitz* offered visions of nuclear holocaust. The film versions of *On the Beach* and *Fail-Safe*, as well as Stanley Kubrick's brilliant satire, *Dr. Strangelove*, attracted large audiences.

The Eisenhower Administration was especially concerned about *On the Beach*. In December 1959 civil-defense director Leo Hoegh criticized it at a Cabinet meeting as "very harmful because it produced a feeling of utter hopelessness, thus undermining OCDM's [Office of Civil and Defense Management] efforts to encourage preparedness." An analysis of the film by the State Department and the U.S. Information Agency warned that its "strong emotional appeal for banning nuclear weapons could conceivably lead audiences to think in terms of radical solutions . . . rather than . . . practical safeguarded disarmament measures." Insisting that the film's ending, in which the doomed Australians choose suicide in preference to death from radioactivity, "grossly misconstrues the basic nature of man," this analysis declared: "It is inconceivable that even in the event of a nuclear war, mankind would not have the strength and ingenuity to take all possible steps toward self-preservation."



Alf Landon, Eleanor Roosevelt, Walter Reuther and Norman Thomas at the SANE rally at Madison Square Garden, May 1960. (*Courtesy Swarthmore College Peace Collection, Records of SANE*)

The nuclear preoccupation of the years 1954–1963 was manifest at all cultural levels. Television series like "The Outer Limits" and Rod Serling's "The Twilight Zone," when not dealing explicitly with radioactivity, genetic mutation and atomic war, conjured up tales of vague, unseen menaces. A spate of mutant movies—*The H-Man, The Incredible Shrinking Man, Attack of the Crab Monsters, The Blob, It, Them*—had clear psychological roots in fears of genetic damage from radioactive fallout. At the end of *Them*, when 12-foot ants emerge from a New Mexico test site, the scientist-hero draws the moral that in the nuclear age such things must be expected. Small wonder the 1963 Test Ban aroused such euphoria!

IT IS WHAT HAPPENED *next* that is surprising. The sudden fading of the nuclear-weapons issue after September 1963, whether as an activist cause, a cultural motif or a topic of public discourse, is striking indeed. Test-ban and nuclear-disarmament organizations either collapsed or faded from public view. When only 25 delegates showed up for the convention of the Student Peace Union in the spring of 1964, the organization disbanded.

One of the first to notice the shift was Eugene Rabinowitch, editor of the *Bulletin of the Atomic Scientists* and a leader of the postwar "scientists' movement" which had campaigned for international atomic control. Writing in the January 1964 *Bulletin*, Rabinowitch observed:

> As the year 1963 drew to its end, it found Americans in a changed mood. A year ago . . . [p]eace movements flourished and disarmament studies proliferated. It looked as if Americans were trying to come to grips with the critical problem of our age.
>
> The acute concern and frantic search for solutions did not last long. . . . The abatement of the Cuban conflict, the test-ban treaty, and vague signs of rapprochement

between the Soviet Union and the United States encouraged the public attention to turn in other directions.

Echoing Rabinowitch, the Catholic journal of opinion *Commonweal* in 1965 deplored the "lethargy" that had enveloped the nuclear-weapons issue. In succeeding years, this lethargy remained a matter of frustrated comment by a few peace activists and social observers. Columnist Stewart Alsop noted in 1967 that "writers rarely write about this subject anymore, and people hardly ever talk about it. . . . in recent years there has been something like a conspiracy of silence about the threat of nuclear holocaust."

Of course, the Bomb did not totally vanish from the American consciousness. In 1965, a *Pacem in Terris* conference in New York sponsored by Robert M. Hutchins's Center for the Study of Democratic Institutions attracted over 2,000 people who heard addresses by Linus Pauling and other veterans of the test-ban movement. In the later 1960s considerable journalistic and public attention focused on the Pentagon's proposal to construct an anti-ballistic missile (ABM) system in North Dakota—a proposal narrowly approved by the Senate in August 1969. And scattered evidence suggests that the nuclear threat remained very much alive, especially among the young, at the subconscious level of nightmares, fantasies and inarticulate forebodings.

What one *does* see, however, is a sharp decline in activism, public discussion and cultural expression focused on the nuclear-weapons issue. In 1959, 64 percent of Americans had listed war (especially nuclear war) as the nation's most urgent problem. By 1965 this figure had dropped to 16 percent, and soon it vanished entirely from the list. Even the ABM debate was confined mainly to strategists, a few columnists and a small band of arms-control specialists. Jerome Wiesner, provost of the Massachusetts Institute of Technology, noted in the June 1967 *Bulletin*, "there seems to be little public concern about the ABM issue, either pro or con."

This climate of apparent obliviousness and unconcern continued well into the 1970s. In 1975, Samuel H. Day, Jr., successor to Eugene Rabinowitch as editor of the *Bulletin*, wrote: "*Public apathy* . . . constitutes perhaps the most ominous of the various forces pulling the world toward a nuclear holocaust." The chorus of lament is striking in its unanimity. "Unless momentarily roused by crisis or threatening alert," asked Richard Rhodes in the *Atlantic* magazine of November 1975, "who among us think of nuclear war anymore?" Reflected Norman Cousins in the *Saturday Review* of April 17, 1976: "Hardly anyone talks anymore about nuclear stockpiles as the world's No. 1 problem. . . . The anti-testing clamor of the Sixties now seems far off and almost unreal." Political journalist Peter Ognibene, in the same issue of the *Saturday Review*, agreed: "Any politician who would now speak, as President Kennedy once did, about 'the nuclear sword of Damocles' poised above our collective head would be dismissed out of hand as an anachronism. The fear of nuclear war, once so great, has steadily receded."

WHY DID THE ERA from 1963 through the 1970s see such quiescence on issues related to nuclear war and the nuclear-arms race? The most reassuring answer would be that the complacency was justified—that the nuclear threat did diminish in these years. By 1975, 106 nations had signed the Test Ban Treaty; 99 had signed the 1968 Nuclear Non-Proliferation Treaty; and the nuclear powers had agreed not to place atomic weapons in space, on the moon, or on the ocean floor.

In 1967 a number of Latin American states pledged by treaty to foreswear nuclear weapons. In 1972 the Strategic Arms Limitation Talks, begun in 1969, produced the SALT I treaties restricting the United States and the Soviet Union to two ABM systems each, and pledging each nation to limit for five years its missile capability to launchers already operational or under construction.

But when one turns from the realm of treaty-making to the real world of nuclear weaponry, a different and bleaker picture emerges. In both the United States and the Soviet Union, nuclear-weapons research, construction and deployment went forward rapidly after 1963. Taking advantage of the Test-Ban Treaty's gaping loophole, both sides developed sophisticated techniques of underground testing. The United States conducted more tests in the five years *after* 1963 than in the five years before, some involving weapons 50 times the size of the Hiroshima bomb. Bernard Feld, editor-in-chief of the *Bulletin*, concluded in the January 1975 issue that the treaty may have been an "ecological blessing," but it was "an arms-control disaster." For one thing, the Treaty's signers did *not* include the nations most likely to develop nuclear weapons. Moreover, as Milton Leitenberg noted in the January 1972 *Bulletin*, "No one believes it will long remain as a viable treaty unless the two major powers begin substantial disarmament."

SALT I, in fact, sidestepped what had by 1972 emerged as the most volatile feature of the nuclear arms race: not the number of missiles, but the growing destructive power and technical sophistication of nuclear weaponry. While the Soviet Union opted for larger ICBMs and warheads, America moved toward diversification and technical refinements such as MIRV, by which each missile could carry up to 16 highly accurate and independently targeted warheads.

What Robert McNamara in 1967 called the "mad momentum" of the nuclear-arms race steadily accelerated in these years. The SALT process had "institutionalized" the competition, observed Swedish arms-control specialist Alva Myrdal in 1976, but "by no stretch of the imagination can this be called arms limitation." In the December 1967 *Bulletin* Milton Leitenberg noted that in the flurry of nuclear treaty-making not a single weapons system had been reduced or dismantled except to be replaced by a more modern one.

WITH SO LITTLE objective basis for nuclear complacency, why did it occur? Some illuminating speculations on this question have been offered by the Yale psychiatrist

Robert Jay Lifton. In a 1964 article in *Psychiatry*, and then more fully in his 1968 book *Death in Life*, he advanced the concept of "psychic numbing" to explain how Hiroshima survivors had managed to carry on with life after their experience of mind-searing catastrophe.

Going further, Lifton applied the same analytic concept to those facing the *possibility* of nuclear annihilation. Americans resemble the Hiroshima survivors "more than we realize," he speculated, living, like them, "in a world . . . dominated by holocaust—past, contemporary, and anticipated." The prospect of a nuclear end to history, he said, robs people of that sense of "symbolic immortality"—the anticipation of "living on" through one's offspring, one's works, even through nature itself—which hitherto had helped people to accept their personal death. Unable to confront this loss, we submerge threatening knowledge and childhood fantasies of annihilation and deny our nuclear awareness.

This "nuclear-induced psychic numbing," Lifton insists, is "more than a defense mechanism. It really amounts to a reorientation of the entire self, with a muting of overall responses to the nuclear environment." So threatening is reality that "to go about 'business as usual,' one has to deaden one's feelings about what one knows." Beneath the numbed surface, however, the "nuclear obsession" remains, affecting individuals and the culture in far-reaching ways. In his more speculative moods, Lifton sees many aspects of contemporary culture—the narcissism; the ephemerality of relationships; the resurgence of occultism and other-worldly religions—as nuclear-induced phenomena.

With the widespread diffusion of Lifton's ideas, "psychic numbing" has emerged as an accepted explanation for society's nuclear passivity. But suggestive as it is, the concept does not fully explain the alternating cycles of engagement, apathy and renewed engagement marking Americans' response to the Bomb. It tends to reduce the complex texture of history to a single procrustean psychological formula.

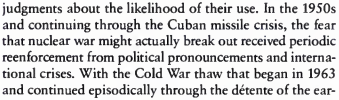
Confronted with such an all-encompassing explanatory concept, the historian is inclined to try to flesh it out with more specific historical content. At times since 1945, clearly, the political and cultural currents have run *counter* to the individual propensity to "psychic numbing"; in other periods, the cultural climate has *encouraged* that tendency. Keeping Lifton's insights in mind, then, we must continue to ask ourselves why the years from 1963 to the later 1970s saw such a diminution of nuclear activism and awareness.

Many have attributed it to the influence of the Defense Department and the major military contractors. Writing in 1970, one arms-control advocate blamed nuclear passivity on the Pentagon's "in-house steam roller" which "forges ahead over all objections." Certainly few would deny the reality of the military-industrial complex. For the principal military contractors and their hundreds of subsidiaries, as indeed for entire regions of the country, nuclear-weapons research, development and construction represent economic interests of vast proportions. But simply because the military-industrial complex has powerful economic incentives for shaping public attitudes in certain ways, does this mean it therefore has the power to do so?

Certainly the military services and corporate interests engaged in planning and producing nuclear weapons have their media outlets, and their influence on public perceptions is formidable. But this does not seem a fully sufficient explanation. Like Lifton's "psychic numbing" it is not time-specific; it cannot account for *variations* in public responses to the nuclear threat. Nuclear-weapons research and development have loomed large since the early 1950s; yet these years have seen dramatic shifts in the level of activism and cultural expression directed to this issue. The question, then, remains: Why did nuclear awareness and activism decline so precipitously in the period we are examining? Several reasons suggest themselves.

• *The perception of diminished risk.* If the various treaties of these years failed to slow the nuclear-arms race, they did convey the *appearance* of progress. For those already tending to psychic denial, this appearance provided a plausible rationalization. To nuclear activists, this situation was intensely frustrating: "The elaborate staging of arms control negotiations," wrote Samuel H. Day, Jr. in the September 1975 *Bulletin* "doubtless persuaded many that the threat is diminishing."

Nor, perhaps, was this perception entirely illusory. The intensity of nuclear fear at any given moment is presumably influenced by two distinct though connected realities: the quantity and nature of the world's nuclear arsenals, and judgments about the likelihood of their use. In the 1950s and continuing through the Cuban missile crisis, the fear that nuclear war might actually break out received periodic reenforcement from political pronouncements and international crises. With the Cold War thaw that began in 1963 and continued episodically through the détente of the ear-



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ly 1970s, the diminution of nuclear-war fear had a certain rational basis, despite the superpowers' growing nuclear arsenals.

• *The loss of immediacy.* Memories of Hiroshima and Nagasaki were dimming; civil defense was played down; and with atmospheric tests no longer dominating the media, the world's nuclear stockpile seemed increasingly unreal.

"Familiarity takes the sting out of practically anything, even Armageddon," noted journalist P.E. Schneider in the *New York Times Magazine* of August 14, 1966; "Nuclear weapons constitute a danger so theoretical, so remote, as to be almost non-existent." Psychiatrist Jerome Frank made this point in 1967: "Nuclear missiles poised to kill cannot be seen, felt, tasted, or smelled, and so we scarcely think of them." With the end of above-ground testing, observed the *New York Times* in 1969, nuclear fear had become "diffuse and inchoate." "Our capacity for . . . response is dulled," agreed MIT physicist and arms-control advocate Kosta Tsipis in 1972, "because the danger is not present to our daily experience; it is a mental image . . . inconceivable to the large majority."

This loss of immediacy was furthered by the abstract vocabulary of nuclear strategists and weapons technicians. These years brought an array of acronyms confusing enough to make even a New Dealer blush: ABM, AWACS, ELF, FOBS, MIRV, MARV, SLBM, GLCM, MX, TNW and so on. Even the names given the various missile systems evoked not their actual doomsday potential but reassuring associations with the heavens, classical mythology, American history and even popular slang: Polaris, Nike-Zeus, Poseidon, Tomahawk, Minuteman, Pershing, Davy Crockett, Hound Dog.

The loss of immediacy was self-reenforcing. As nuclear weapons literally went underground after 1963, the torrent of novels, movies and television programs which had both fed and reflected the culture's nuclear fears slowed to a trickle. This, in turn, facilitated the numbing process. Remote and largely invisible, the nuclear-weapons issue was particularly ill-suited to the insatiable visual demands of television. After 1963, the Bomb's "corporate logo," the mushroom-shaped cloud, became a dated visual cliché, embalmed in history textbooks where it had little more affective power than the lithographs of shivering soldiers at Valley Forge.

Some tried to restore the lost sense of immediacy. In the 1970s, Catholic activists Daniel Berrigan and his brother Philip took hammers to missiles on the production line, as in 1968 they had poured blood on draft records. In 1970, two University of Missouri sociologists showed their students the documentary film *Hiroshima/Nagasaki*, which portrays the victims' sufferings in horrifying detail. Predictably, when tested immediately afterwards, the students showed a heightened resistance to the idea of nuclear war. But for how long? Was it like the well-known phenomenon when drivers creep along for a few miles after passing a terrible highway accident, only to speed up again as the memory fades?

• *The neutralizing effect of the "peaceful atom."* President Eisenhower launched the international "Atoms for Peace" program as early as 1953, and the first domestic nuclear power plant opened in 1957. But it was in the mid-1960s that the program really gained momentum. By 1973, 37 plants were in operation in the United States, with many more planned. Concurrently, the atom's peacetime potential was given enormous publicity.

The most indefatigable cheerleader was Nobel laureate Glenn T. Seaborg, chemist and chairman of the Atomic Energy Commission from 1961 to 1970. In speeches, articles, and interviews appearing in the *Bulletin* and elsewhere, Seaborg described the nuclear utopia ahead: cheap power, medical wonders, agricultural abundance, a "junkless society" through the nuclear processing of waste materials, "international understanding and peace" thanks to nuclear-powered communications satellites. "Designed to blend into the natural landscape, low in profile . . . with all the distribution lines underground," and nestled in "park-like settings," Seaborg declared, future nuclear-power plants would be "as close to an extension of nature as any human enterprise." The expansive Texan in the White House echoed Seaborg's enthusiasm. In 1967, Lyndon Johnson delivered a speech entitled "Nuclear Power: Key to a Golden Age of Mankind."

In the nation's collective unconscious (if one may loosely use that Jungian term), a kind of psychological trade-off seems to have occurred, with glowing images of the benevolent atom obscuring and to a degree neutralizing dark images of the destroying atom. Political scientist and nuclear strategist Albert Wohlstetter observed in the April 1968 *Bulletin*: "Immediate bright hopes for civilian nuclear energy have been an emotional counterweight to . . . nuclear destruction." Indeed, the matter was often implicitly presented as a kind of zero-sum game: support nuclear power, and the threat of nuclear war will diminish correspondingly. As *U.S. News and World Report* put it in December 1967, the world had wandered far down the nuclear-weapons path, but was now at last crossing "the threshold into the era of the peaceful atom, with its promise of better things for all mankind."

In a 1967 speech entitled "Need We Fear Our Nuclear Future?" Glenn Seaborg managed a resounding "No" by the simple expedient of never mentioning weapons. In reality, however, there were not two separate worlds of atomic energy but only one, whose various aspects were deeply intertwined. Still, for a time, the allure of the peaceful atom played its part in muting fears of nuclear weapons.

• *The complexity and reassurance of nuclear strategy.* From 1945 to 1950, and continuing into John Foster Dulles's days as secretary of state, atomic strategy as practiced in Washington was a fairly simple (if often unnerving) matter. By the 1960s, however, it had become an arcane pursuit dominated by a small group of civilian experts under contract to the military and based at semi-autonomous research institutes at the larger universities or at "think tanks" such as the Institute for Defense Analyses, the System Develop-

ment Corporation, the Center for Naval Analysis, the Research Analysis Corporation and the RAND Corporation.

Utilizing computer simulations, John von Neumann's game theory and other analytical tools, these "defense intellectuals" transformed nuclear strategy into a rarefied, quasi-scientific discipline. Conveying "the impression of holding membership in a closed club," as the *New Yorker* put it on January 9, 1971, they increasingly moved in their own intellectual and even social orbit.

Ralp Lapp called them "the new priesthood," noting that even in academia, with its tradition of scholarly openness, "they enjoy a privileged area of argument and can always retreat to a sanctuary of secret dataland." The names of only one or two of even the top strategists—Herman Kahn, Thomas Schelling, Henry Kissinger, Donald Brennan, Bernard Brodie, William Kintner, Fred Iklé, Oskar Morgenstern, Robert Strausz-Hupé, William Kaufmann, Albert Wohlstetter, Glenn Snyder—would have been recognizable to the politically attentive public.

As for the strategic theories they debated, only the dimmest awareness—analogous, perhaps, to a medieval peasant's grasp of the theological concepts with which Thomas Aquinas wrestled—filtered beyond the walls of the institutes and think tanks. This had a profoundly chilling effect not only on potential activists, but also on those citizens seeking to remain informed on nuclear issues. As early as 1959 Robert M. Hutchins questioned whether democratic theory retained much relevance in the new era of strategic planning, and such apprehensions gained force in succeeding years. Political scientist Hans Morgenthau, in the mid-1960s, stated:

> The great issues of nuclear strategy . . . cannot even be the object of meaningful debate . . . because there can be no competent judgments without meaningful knowledge. Thus the great national decisions of life or death are rendered by technological elites, and both the Congress and the people retain little more than the illusion of making the decisions which the theory of democracy supposes them to make.

The substance as well as the process of nuclear strategy changed in these years. As the Soviets moved toward parity with the United States in nuclear warheads and ICBMs, American atomic sabre-rattling gave way to a new strategic emphasis: deterrence. The essential elements of deterrence theory had been developed by the Yale political scientist Bernard Brodie in a seminal 1946 work, *The Absolute Weapon: Atomic Power and World Order*, and elaborated by Albert Wohlstetter in a 1954 RAND study published as "The Delicate Balance of Terror" in the January 1959 issue of *Foreign Affairs*.

It was in the 1960s, however, and particularly toward the end of Robert McNamara's tenure as secretary of defense, that deterrence theory was officially endorsed and given extensive public visibility as the cornerstone of U.S. nuclear strategy. As elaborated by McNamara in 1967, deterrence theory held that the point of stockpiling nuclear weapons was not the anticipation of ever *using* them, but of *preventing* their use by the other side.

Specifically, the Soviets had to be convinced that a nuclear first strike by them would trigger a retaliatory "second strike" that would devastate their country. In McNamara's memorable words, nuclear security lay in "mutual assured destruction," that is, "the certainty of suicide to the aggressor—not merely to his military forces, but to his society as a whole." By challenging the common-sense assumption that the vast buildup of nuclear weapons increased the likelihood of their eventual use, deterrence theory helped mute nuclear fears and activist impulses.

Not all Americans found deterrence theory persuasive. To disarmament advocates and others who believed that the reduction and eventual elimination of nuclear weapons should be a fundamental objective of U.S. policy, the abandonment of this goal, implicit in deterrence theory, was dismaying. In the 1950s and early 1960s, deterrence was subject to heavy criticism on these grounds. Such criticism diminished after 1963, reflecting the larger cultural shift we have been examining, but it never disappeared entirely.

The shift of attention to Vietnam removed "much of the public pressure on the American government to alter its nuclear policies."

Many who approached the nuclear dilemma from a religious or ethical perspective were appalled by the moral implications of a strategy predicated on the threat to wipe out an entire society. The elaborate edifice of deterrence theory rested on the threat of retaliation and the threat had to be *credible* for the theory to make any sense. Robert McNamara insisted on the government's "unwavering will" should the awful moment of decision ever come. And in the *New York Times Magazine* of June 7, 1964, Walt W. Rostow, chairman of the State Department's policy planning council, assented: "The heart of a credible deterrent in a nuclear age lies in being prepared to face the consequences, should deterrence fail." American security, Rostow went on, demanded an unflinching readiness to match any Soviet escalation "up to and including all-out nuclear war."

It was precisely here that the moral dilemma lay, giving rise to considerable soul-searching in religious circles, not only in the historic peace churches—Quaker, Mennonite, Church of the Brethren—but also in the mainstream Protestant denominations and even in the Roman Catholic hierarchy, traditionally a bastion of support for a policy of

military strength. In 1965, drawing upon the church's traditional just war doctrine, Vatican Council II declared: "Any act of war aimed indiscriminately at the destruction of entire cities and of extensive areas along with their population is a crime against God and man himself. It merits unequivocal and unhesitating condemnation."

What, then, was the church to say of a strategy whose avowed aim was to avoid nuclear war, but which depended on the "unwavering will" to destroy an entire people should the strategy fail? "Surely there is something obscene," said the Catholic journal *Commonweal* in 1971, in a policy predicated upon such a threat. What if human error, technological malfunction, or some unforeseeable combination of circumstances triggered an attack, or led to the mistaken impression that one was under way? The consequences if deterrence failed through mischance were awful to contemplate.

At the other end of the spectrum, many strategists, Pentagon planners and weapons researchers never fully accepted the operational implications of deterrence theory. New weapons proposals continued to proliferate beyond any rational deterrent need. And even after McNamara publicly endorsed deterrence theory, the Pentagon's computerized war plan, SIOP (Single Integrated Operational Plan), continued to give targeting preference to Soviet military sites and missile bases, reflecting not only the deterrent principle but also the desire to maintain an actual nuclear warfighting capability.

Important as these qualifications were, deterrence theory as publicized in the later 1960s clearly reenforced the "psychic numbing" process for many Americans. It offered hope that ultimately the nuclear arms race would reach a point of stable equilibrium. Once each side had achieved a credible second-strike capability (McNamara's "mutual assured destruction"), the race would end in a tie. Nuclear warheads would remain, but they would simply rest in their silos and submarine bays forever, endlessly deterring. Thanks in part to this theory, editorialized *Business Week* on July 13, 1968, "living with the atomic bomb has turned out to be less frightening than it once seemed."

• *The Vietnam War and the rise of the New Left.* The nuclear-weapons issue did not exist in a vacuum in these years; it was but one element of a complex cultural and political reality. Even as Americans hailed the Test-Ban Treaty, Vietnam was looming. From the major escalation of February 1965 to the final helicopter evacuation of Americans from Saigon a little over a decade later, the Vietnam conflict ruled the media and obsessed the national consciousness.

Between 1965 and 1970 the War also drew intensifying waves of protest. From the first teach-in at the University of Michigan in March 1965 to the final convulsive demonstrations on college campuses and in Washington, D.C. against the Cambodian invasion of May 1970, the war in Southeast Asia was the focus of activist energy. For peace activists, many religious leaders, college students facing the draft and ultimately for countless Americans of no strong ideological bent, a war that was claiming thousands of lives, devastating entire regions and turning hundreds of thousands of blameless peasants into refugees had a moral urgency that could not be denied.

Even as media events, the war and the domestic turmoil it engendered had an immediacy that the more abstract nuclear-weapons issue could not begin to approximate. "The second round of Strategic Arms Limitation Talks have started in Geneva," the *Wall Street Journal* could report as late as January 11, 1973, "though even an attentive newspaper reader would scarcely have noticed amid the distractions of Vietnam hopes and fears."

From this perspective, the nuclear issue seems not so much to have been consciously set aside as pushed to the background. The Bomb was a potential menace; Vietnam was actuality. When a 1969 Gallup Poll asked subjects to list the "two or three most important problems" facing the nation, 63 percent mentioned Vietnam and only 2 percent the danger of nuclear war. The shift of attention to Vietnam and away from nuclear policy, according to Roy E. Licklider in his 1971 book, *Private Nuclear Strategists*, removed "much of the public pressure on the American government to alter its nuclear policies."

The impact of Vietnam on the nuclear disarmament movement is vividly illustrated in the history of SANE. While some SANE directors, including co-chairman Benjamin Spock, shifted entirely to the Vietnam issue, others strove to keep the anti-nuclear cause paramount. At an executive board meeting in July 1966, a catch-all entry entitled "Disarmament—Nuclear Tests—Non-Proliferation" appeared as Item 9 on a long agenda otherwise devoted to Vietnam and related matters. The minutes for Item 9 are revealing: "The board discussed these issues briefly, recognizing the necessity for continued attention and action, but noted that the Vietnam issue must receive the major emphasis until the war is ended."

But deep differences remained. When Spock and other leaders of SANE increasingly linked the organization to the most militant wing of the anti-war movement, particularly at the National Conference for a New Politics held in Chicago in September 1967, these differences exploded openly. Executive director Donald Keys and Norman Cousins resigned; Spock himself soon departed. A shadow of its former self, SANE in 1969 dropped the word "Nuclear" from its name.

Similar seismic shifts were occurring throughout the nuclear-disarmament movement. At the University of Wisconsin, Students for Peace and Disarmament, founded in 1962 to oppose nuclear testing and the arms race, dropped the nuclear issue abruptly in the fall of 1963 to organize a rally protesting America's deepening involvement in Vietnam. Understandable and even inevitable as it seems in retrospect, this process was distressing to the dwindling band of older activists who continued to focus on the nuclear threat. "From the long-range . . . point of view," wrote David Inglis in the May 1967 *Bulletin*, "the most tragic feature of the war in Vietnam . . . is that preoccupation

with this struggle is being allowed to stand in the way of the urgent business of making a far more devastating nuclear war less likely."

A CLOSELY RELATED influence on post-1963 American nuclear attitudes was the emergence of the New Left, particularly the campus-based radical organization, Students for a Democratic Society (SDS). Founded in 1960 as an offshoot of the socialist League for Industrial Democracy, SDS at its peak in 1968 had some 7,000 members, with upwards of 40,000 more affiliated with local campus branches. It would be foolhardy to treat SDS, or even a more loosely defined "New Left," as synonymous with the large and diverse 1960s antiwar movement. Even the New Left itself was notoriously amorphous; John Diggins, in *The American Left in the Twentieth Century* (1973), called it "a mood in search of a movement." Nevertheless, New Left ideology was one important force shaping 1960s activism, and it merits attention in this context.

At the rhetorical level, the New Left talked a lot about nuclear weapons. In their 1962 Port Huron statement, SDS founders proclaimed themselves seared by atomic fears "when we were kids" and "guided by the sense that we may be the last generation in the experiment with living." "Our hopes for the future have been corroded by the Bomb," added the SDS 1963 manifesto, *America and the New Era*.

Adult sympathizers helped spread the idea that the activists' lifelong association with nuclear weapons was crucial to their political orientation and gave them a unique moral sensitivity. "The bomb has had a wide, corrosive, and depressing effect upon the young," wrote novelist Fletcher Knebel in the December 1968 issue of *Popular Science*. "They sing their sad laments over guitars while the girls' long hair weeps for the coming suicide of humanity."

But when one moves beyond the rhetoric, it is striking how little serious attention the New Left gave to the nuclear issue, and how little effort it made to sustain the direction of the pre-1963 nuclear-disarmament movement. "It's just a cliché" was the succinct comment of one Harvard activist on the claim that the New Left's outlook was profoundly shaped by the looming shadow of the Bomb.

Nuclear disarmament was doubtless implicit in the New Left's vision, but one finds few specifics in the literature. When nuclear weapons are mentioned, it is usually as part of an exposé of the universities' role in military research, or a more general indictment of capitalist society. In his 1969 book *The Making of a Counter Culture* Theodore Roszak agreed that the issue was not simply nuclear weapons but "the total *ethos* of the bomb"—an ethos that also pervaded "our culture, our public morality, our economic life, our intellectual endeavors." The central significance of "the shadow of thermonuclear annihilation beneath which we cower," said Roszak, was as "the prime symptom" of morbidity in a society that was "fatally and contagiously diseased."

The vague and general talk about "the Bomb" in New Left circles sometimes suggests an effort to establish at least a rhetorical link with the earlier anti-nuclear-weapons campaign. What in fact emerges, however, is the sharp discontinuity between the two movements. The conventional explanation—that Vietnam preempted all other concerns—certainly has validity; but the discontinuity is rooted as well in the inner history of the test-ban movement in the early 1960s and in the effect of this history on the New Left in its formative stages.

From the first, relations between the test-ban and nuclear-disarmament organizations and student activists were tenuous. Organizations like SANE sought to shape public policy through speeches, sober pronouncements and advertisements heavily weighted with famous names, and through its access to sympathetic politicians. SANE's 1960 Madison Square rally notwithstanding, its members were not oriented toward demonstrations, marches and mass action. SANE's campus branch, Students for a Sane Nuclear Policy, enjoyed little autonomy. "On arms control, we weren't looking for help from the youthful *polloi*," one SANE leader has candidly acknowledged. The campus-based Student Peace Union emerged in 1959 partially in frustration with SANE's rigidity, exclusivity and general stodginess.

These latent stresses were vastly exacerbated early in 1960 when Senator Thomas Dodd of Connecticut charged that SANE was infiltrated by Communists. An alarmed Norman Cousins privately assured Dodd that SANE was determined to rid itself of any taint of disloyalty. SANE's national board excluded Communists from membership, revoked the charter of the Greater New York Committee (a major target of Dodd's charges), and pointedly announced that SANE was a "deliberately autocratic organization" whose membership could be closely monitored.

All this caused an upheaval in SANE and the peace movement. Several directors resigned and SANE's student branch broke away from the parent organization. Campus groups committed to a test ban and nuclear disarmament, but independent of SANE, proliferated: Tocsin at Harvard, SLATE at Berkeley, Students for Peace and Disarmament at Wisconsin, and so on. The pace of activism—marches, demonstrations, petitions—quickened markedly. A San Francisco peace march in October 1960 drew 2,000 participants. Women's Strike for Peace, a grassroots movement started in the Washington, D.C. area in 1961, quickly organized demonstrations in 60 cities involving 50,000 women. Discontent with SANE and similar narrowly based groups intensified. The *Nation*, in its March 3, 1962, issue saw in the realignments and ferment of 1960–1962 not just a new phase of the peace movement, but "the birth of a new one."

The volatility of the situation emerged clearly in February 1962 when a coalition of campus peace groups led by Todd Gitlin and Peter Goldmark of Tocsin organized the Washington Project which drew 5,000 students to the nation's capital. Some met with senators, congressmen and State Department officials. But others—the wave of the future—held a mass meeting and took to the streets, marching, chanting and waving placards for nuclear disarmament.

By 1962, then, thousands of students had abandoned SANE's approach in favor of direct-action strategies aimed at fomenting a mass movement against nuclear testing and the nuclear-arms race. With the Test-Ban Treaty of 1963, the urgency drained from the nuclear issue, but the activist zeal and the spirit of tactical innovation remained. Waiting in the wings was SDS. For many students, the "new" peace movement of 1960–1962 provided a bridge to the New Left.

The early New Left was determined to avoid what it saw as the failings of SANE and the 1950s peace movement. Unlike SANE, Students for a Democratic Society adopted a "non-exclusionist" membership policy, prized face-to-face relations and the spirit of community, and was casually organized and decentralized to the point of chaos.

The differences in tactics were no less pronounced than were those of structure and style. SANE relied on its access to Washington power wielders and its ability to influence the educated middle class through the prestige of its sponsors and the impact of its psychologically manipulative (if factually sound) advertisements. The early SDS, by contrast, focused on the poor; prided itself on its non-manipulative, non-exploitive approach; and adopted a posture of radical opposition to the Establishment.

With a grant from the United Auto Workers, the SDS Economic Research and Action Project in 1963–1964 sent organizers into ghettoes and slums to discuss the residents' grievances, help them plan protest actions, and gradually lead them to an awareness of the larger power realities and class inequities that shaped their lives. In gradual stages, the poor would be radicalized and become a part of the force contributing to the emergence of a new social order. "Only in this way," wrote SDS president Tom Hayden in *Dissent* (January/February 1966), "can a movement be built which the Establishment can neither buy off nor manage." The group's Port Huron statement gave a name to this strategy: participatory democracy. An article of faith for the early New Left, this concept was both its most significant contribution to the radical tradition and its most explicit repudiation of SANE and much of the 1950s peace movement.

SDS community organizers quickly found that the nuclear-arms race ranked well below such matters as garbage collection on the list of slum dwellers' concerns. Indeed, as one activist later wrote, the poor were often openly hostile to "large, organization-funded, top-down peace propaganda programs." This realization widened still further the New Left's distance from the nuclear disarmament issue.

If SANE was the negative role model for the early New Left, the civil rights movement was the positive model. The tactics of black activist groups like SNCC (Student Nonviolent Coordinating Committee), with its sit-ins and marches, seemed eminently more promising—and exciting—than the staid, desk-bound approach of organizations like SANE. Black activists understandably gave other issues priority over the nuclear-arms race, reenforcing the inclination of their white emulators in the New Left to do the same.

Ideological as well as tactical considerations underlay the early New Left's downgrading of the nuclear-weapons issue. Assuming that the Washington technocrats understood the irrationality of nuclear war and an out-of-control nuclear arms race, SDS further assumed that they would devise ways to avoid them. This assumption emerges most clearly in the 1963 manifesto *America and the New Era*, written soon after the Test-Ban Treaty was announced. Citing this agreement as well as "other first-step efforts at curtailing the arms race," this analysis concluded: "A deep desire to avoid general nuclear war is fundamental to the Administration's 'rational military policies'. . . . The Administration recognizes that some forms of agreement with the Soviet Union are necessary if nuclear war is to be prevented." But while the technocratic managers in Washington could be counted on to avoid nuclear war and a spiraling nuclear arms race, SDS went on, they would not hesitate to engage in subversion, counter-insurgency wars, and other (non-nuclear) power tactics to protect corporate America's global political and economic interests.

The radicals' assumption that rational calculations and the managerial skill of the technocratic elite would prevent nuclear war despite the continued existence of vast nuclear arsenals (an assumption they shared with the deterrence theorists) was a remarkable gesture of faith in human reason and technocratic expertise. As such, it represented a sharp break with the activist perspective and cultural ethos of the 1950s and early 1960s which viewed the nuclear arms race as a fundamentally irrational, unstable and highly dangerous process that might at any time escape from control through accident, technical breakdown or some sudden escalation of local conflict. The early New Left, for all its talk of "the looming shadow of the Bomb," did not share such fears—or at least did not systematically explore them in its theoretical work or embody them in its operational planning.

THE RELATIONSHIP between the radical movement of the 1960s and the nuclear-weapons issue, then, was a complex and subtle one. Certainly after 1965 Vietnam was important in pushing the nuclear issue to the background. But even earlier, the ideological and tactical thrust of the New Left had led it to break decisively with the organized test-ban and nuclear-disarmament activism of the 1950s. Convinced of the superiority of its tactics and the greater penetration of its political analysis, it played down its roots in the anti-nuclear-weapons and test-ban movements. The earlier campaign was significant, New Left ideologues suggested, insofar as it had propelled some of its adherents beyond liberal reformism to a larger radical consciousness.

Even such qualified efforts at rapprochement soon faded. In *The Making of a Counter Culture* Theodore Roszak, himself a veteran of the earlier peace movement, wrote:

> Precisely what do groups like SANE . . . tell us about adult America even when we are dealing with political-

ly conscious elements? Looking back, one is struck by their absurd shallowness and conformism, their total unwillingness to raise fundamental issues about the quality of American life, their fastidious anti-communism, and above all their incapacity to sustain any significant initiative on the political landscape.

Roszak's analysis is insightful, but its dismissive, contemptuous tone also indicates the depth of the chasm between the radicals of the New Left and the earlier nuclear-weapons protest movement.

The New Left's hostility toward the older generation of nuclear activists was in many instances fully reciprocated. Eugene Rabinowitch, then editor of the *Bulletin,* was deeply critical of the 1960s activists, expressing his dismay in editorials with titles like "Student Rebellion: The Aimless Revolution?" in the September 1968 issue and "The Stoning of America" in November 1971—a bitter attack on Charles Reich's *The Greening of America* (1970).

One of the bitterest denunciations came from Donald Keys, SANE's executive director. The differences between the New Left and older organizations like SANE, he said, were fundamental. SANE believed in democracy and in the "common sense and goodwill" of the American people, and placed "communication and dialogue with the public and the power structure at the center of its approach." SANE believed in working through the system for its broad-ranging but nevertheless limited goals. New Left radicals, by contrast, "reject the democratic process, encourage violence, and offer only protest and opposition." Young people, "becoming conscious of social issues for the first time," Keys went on, had reacted "in a total way against the hypocrisy, gross materialism, and dehumanization of their society" and seemed unable or unwilling to "compartmentalize or fragment their response." Between two such divergent approaches, concluded Keys, there was no common ground. As he put it in a November 13, 1967 memorandum to SANE, "The two major trends in the peace movement are by their nature incompatible and mutually divergent." The breakdown of communication and mutual respect between the New Left and the activists who for years had worked against the menace of nuclear war could hardly have been more complete.

By the later 1970s, the logjam of circumstances that for more than a decade had mired the American public in nuclear apathy was rapidly breaking up, giving way to the early stirrings of renewed political activism and cultural attention. But much time had been lost. From the early 1960s to the late 1970s, most Americans had seemed oblivious to a danger that many in earlier years, and many others in the years to follow, considered the most urgent ever to confront the nation, and indeed the entire human race. □

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Fair government regulations would prevent the nuclear power industry from passing on to taxpayers the costs of its considerable economic externalities.

Who pays for radioactive rubbish?



Paul Valerry, West Germany

by John Abbotts

NUCLEAR REGULATORY COMMISSION requirements, until 1982, specified that reactor licensees must demonstrate financial qualifications to "cover the estimated costs of operation for the period of the license" plus "the estimated costs of permanently shutting the facility down and maintaining it in a safe condition."[1] The Three Mile Island accident of March 1979 represented a significant challenge to these regulations.

General Public Utilities, the holding company owning the plant, maintained property damage insurance of $300 million, the maximum available, on the crippled reactor. Estimated costs of repairing and decontaminating the plant, set at $140 million two weeks afters the accident, escalated rapidly to $1 billion by November 1980.[2] Future estimates are likely to be even larger.

General Public Utilities has frequently complained that it faces bankruptcy, but to solve its self-inflicted economic problems, the company has turned to taxpayers, not to its investors. In December 1980, the utility filed a claim with the Nuclear Regulatory Commission—which amounts to a backdoor application for taxpayer subsidies—for $4 billion in accident damages. And after heavy lobbying by the utility company, the Department of Energy agreed to commit $159 million for the Three Mile Island cleanup.[3]

Whether or not General Public Utilities succeeds in charging ordinary citizens, as ratepayers or taxpayers, for its own mismanagement, the company has demonstrated that it is incapable of funding a reactor accident decontamination. Nor is any other utility likely to be financially capable of recovering from such an accident. Yet it would seem prudent for utilities to plan for such an event.

Accordingly, in January 1981 I petitioned the Nuclear Regulatory Commission to issue an order to all reactor owners, requiring them to show cause why their licenses should not be revoked because they could not fund the cleanup of serious reactor accidents, and thereby failed to meet the Commission's standards on financial qualifications. The petition urged the commission to issue such an order "to uphold the integrity of its own regulations and to protect taxpayers from the hidden costs of atomic power."[4]

Almost a year later, the Commission denied the petition; and in March 1982, that body revoked not licenses, but its offending regulations. It eliminated its financial qualification requirements as they apply to electric utilities, requiring instead that the utilities obtain the maximum available property damage insurance—a measure which sanctified existing industry practice and was admittedly inadequate for the Three Mile Island accident.[5]

At the same time, Commission Chairman Nunzio Palladino wrote to key members of Congress, noting that the cleanup "must be accelerated," and calling for "greater federal participation" in financing the decontamination—a thinly veiled euphemism for government loans, guarantees or direct payments.[6] The chairman's urgency was inconsistent with the Commission's denial of my "show cause" petition. There is a proper role for greater federal participation in the Three Mile Island cleanup, but it is through a mechanism that the Commission seems reluctant to employ—regulation. If the Commission were to put the industry on notice that reactor operation would cease until private funds were made available for Three Mile Island, the industry would find some way to finance the decontamination without charging taxpayers.

The Commission's handling of my petition may have achieved new levels of bureaucratic sleight-of-hand, but its members cannot wish away the reality that nuclear utilities are financially ill-equipped to handle accidents which produce serious radioactive contamination. The group's actions were unfortunately typical of a federal establishment that has responded only grudgingly to the long-term threats to public and economic health from the "nuclear fuel cycle"—the steps of uranium processing and byproduct disposition that support reactor operation.

Nuclear power generation creates radioactive byproducts that society will have to manage, store and guard long after the power is consumed, and almost certainly long after the corporations profiting from it have disappeared. Such remnants of the fuel cycle include uranium mill tailings, reactors contaminated by accidents or normal operation, and low-level and high-level atomic waste.

These fuel cycle effects produce economic externalities

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which challenge "business as usual" attitudes toward regulatory and financial issues. Thus far, federal agencies have been slow to meet this challenge. It has taken the pressure of serious problems or prodding by independent organizations to make agencies grudgingly begin to address the financial issues involved. In some cases, the Nuclear Regulatory Commission did not move until outside groups formally petitioned the agency to address specific steps in the fuel cycle. Thus, a generic defect in federal nuclear power regulation has been the failure to establish institutional arrangements to fund the fuel cycle's economic externalities. A few short case histories will demonstrate this lethargy.

Uranium mill tailings. After uranium ore is mined, it is transported to a mill to be crushed, allowing the chemical extraction and concentration of the uranium, which can be further processed for reactor fuel or bombs. The radioactive residue from the crushed ore, a fine, powdery material, is referred to as mill "tailings." Over the years, tailings, which have accumulated at mill sites in enormous piles, have received minimal, if any, attention.

In March 1975, the Natural Resources Defense Council, a nonprofit environmental organization, petitioned the Nuclear Regulatory Commission to correct the "past lax regulatory policies of the Atomic Energy Commission" and to address the public health hazard represented by uranium mill tailings piles throughout the western states. The Council noted the existence of tens of millions of tons of mill tailings, commenting that there was "no coherent overall strategy or plan to prevent the critical radionuclides in existing and future mill tailings from entering the biosphere in toxic amounts."

The Council recommended that the Commission prepare a detailed programmatic environmental impact statement on the uranium milling industry. And it asked the agency to require mill operators to post bonds to cover the estimated costs of "interim stabilization" and "ultimate disposal" of the tailings, to prevent their being blown over the countryside into rivers and potable water supplies, and to prevent radioactive radon gas from escaping the piles.[7]

Mill tailings threaten public health from multiple exposure pathways. Between 1952 and 1966, radioactive tailings from a Climax Uranium Company mill found their way into construction fill underneath or against hundreds of buildings around Grand Junction, Colorado. In the worst cases, occupants were exposed to radiation doses comparable to those received by uranium miners.[8]

In 1972, Congress established a remedial program: Citizens in Grand Junction would abandon their homes temporarily while work crews jack-hammered the foundations, removed and replaced the radioactive fill underneath, and then repaired the floors. Of this program's expenditures—which continue today—75 percent have been paid by U.S. taxpayers and the remainder by the state of Colorado.[9]

The worst radioactive spill in this nation's history originated at a uranium mill. In July 1979, a dam holding a pond full of tailings at the United Nuclear Corporation's Church Rock Mill gave way, releasing 100 million gallons of radioactive water into New Mexico's Puerco River. The resulting flash flood carried radioactive material and toxic heavy metals across the Arizona state line, through a Navajo reservation, and 80 miles downstream of the mill. On the day of the dam failure, samples in the Puerco showed radioactive contamination 6,000 times greater than the allowable limit for drinking water. Residents were advised not to swim in, drink from or otherwise touch the river water, and to prevent their livestock from drinking it.[10]

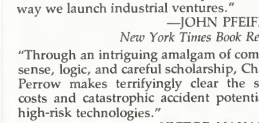
In 1978, Congress instructed the Nuclear Regulatory Commission to regulate tailings at active mills, and to insure that tailings would be stabilized and controlled after operations were terminated. Unfortunately, the congressional act left remedial action on previously abandoned piles to taxpayer funding: the federal government will pay 90 percent and the states the remainder. Although the Justice Department is authorized to determine corporate liability for abandoned tailings, it remains to be seen if the corporations responsible for the piles will be financially penalized for their negligence.

Faced with the Natural Resources Defense Council petition and congressional instructions, the Commission, in October 1980, finally established regulations to stabilize tailings. The Commission noted "the inescapable fact that tailings will, in fact, remain hazardous for extremely long periods of time, hundreds of thousands of years," and required mill licensees to meet the objective of "isolating the tailings and associated contaminants from man and the

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environment during operation and for thousands of years thereafter."[11] The Commission required mill owners to establish, prior to operation, financial surety arrangements sufficient to cover the costs of decontaminating the mill and reclaiming the site when operations were ended; each licensee is also to provide funds for long-term surveillance and maintenance of tailing piles.

The regulations still contain sizable loopholes. The charge for long-term maintenance is not collected until mill operation is terminated, and the amount charged need only be sufficient for annual inspection. No funds would be available for remedial actions if the stabilization methods employed at the end of mill operation prove insufficient to prevent contamination or radiological accidents.[12]

Decommissioning. Reactors in operation convert the structures which support and contain them to radioactive material, which must be managed and guarded when reactors are "decommissioned" at the end of their useful lives—usually 30 to 40 years. For many years, the nuclear industry believed that it could completely decommission reactors by allowing contaminated materials to sit and undergo radioactive decay for about 200 years. But in January 1976, the New York Public Interest Research Group released a study showing that this view was much too optimistic. This study was conducted by Marvin Resnikoff, then physicist and lecturer at the State University of New York at Buffalo, with the assistance of four engineering students.

The long-term costs of the nuclear fuel cycle are inherently inflationary.

In summary, the Group's report found that the Commission and the industry had overlooked the effects of radioactive byproducts produced in stainless steel vessels surrounding a reactor's fuel core: these would remain a radioactive problem for many thousands of years.[13] The general findings of the report were subsequently confirmed by a consultants' study commissioned by the nuclear industry.

In June 1977, the U.S. General Accounting Office characterized decommissioning as a "multibillion dollar problem" and expressed its concern that "NRC has not paid much attention to one of the biggest problems that may confront the public in the future—that is, who will pay the cost of decommissioning nuclear power reactors." As one of its recommendations, the Accounting Office stated:

> We believe the cost of decommissioning should be paid by the current beneficiaries, not by future generations. . . . Private companies have an obligation to accumulate funds for decommissioning during the life of their projects. NRC should make advance planning for decommissioning mandatory at the time of licensing, including provision for funding.[14]

Ralph Nader's Public Interest Research Group, the New York Group and several other consumer and environmental bodies, basing their petition in part on the General Accounting Office report, asked the Commission, in July 1977, to establish reactor decommissioning regulations. The petition included the request that utility owners be required to set aside money, outside the utilities' control, to fund reactor decommissioning and the long-term management of decommissioning waste.[15]

By January 1981, the Commission produced a draft environmental statement on decommissioning which conceded that "A high degree of assurance is required from the nuclear facility licensee that adequate funds are available to decommission the facility. Because of the possibility of premature closure, a funding mechanism provided by the licensee must be in place which would pay for the full cost of decommissioning at any time during facility operation."[16] But the Commission has yet to put final regulations in place. Nor is it clear whether final financial regulations will be designed merely to decommission the reactor by dismantling or other mechanisms; or whether funding will also be sufficient for the long-term management of reactor components which will ultimately be stored as nuclear waste.

Low-level waste. The Nuclear Regulatory Commission has established a category of "low-level" radioactive waste which, if not contaminated beyond specified levels, may legally be buried on land in shallow pits. This category includes items from nuclear reactors: gloves, tools, protective clothing, small pieces of equipment contaminated during reactor operation or maintenance. The limited experience at low-level waste dumps has been marred by financial and technical mismanagement, and in August 1976, the Natural Resources Defense Council petitioned the Commission to adopt regulations on the land burial of low-level waste. The petition also asked the agency to require fees to finance the long-term care of buried waste.[17]

A draft environmental statement, produced by the Commission in September 1981, noted problems at existing burial sites at West Valley, New York; Maxey Flats, Kentucky; and Sheffield, Illinois. (The latter two sites were managed by the Nuclear Engineering Company—now inaptly named U.S. Ecology, Inc.) According to the statement: "Funds being collected for postoperational activities were also inadequate to cover the potential long-term costs involved (particularly the long-term maintenance costs involved) in caring for the sites over the long term. These sites are closed and may require continued active maintenance for many years to assure stability."[18]

This comment understates the financial difficulties of maintaining these abandoned sites. Over the short life of the Maxey Flats site, for example, the Nuclear Engineering Company placed $230,000 in an escrow account to cover maintenance of the facility "in perpetuity." After discovering that radioactive material had migrated off the site, the state of Kentucky forced the Maxey Flats dump to close, and assumed annual maintenance costs of about $100,000.[19] Similarly, Nuclear Fuel Services, Inc. paid about $200,000

into a perpetual care fund for the waste burial facility it managed at West Valley, New York. The state Department of Environmental Conservation forced burial to be suspended in April 1975 because leaks had been discovered in several trenches. The state estimated that pumping out just one trench would cost about $100,000.[20]

In final rules promulgated in December 1982, the Commission required burial ground licensees to demonstrate adequate financial qualifications to operate their facilities and to provide adequate financial provisions for site closure. But once again, the regulations contain serious loopholes: By requiring federal or state ownership of burial site land, insuring that the land will revert to the government upon site closure, the regulations also insure that any insufficiency of funds for long-term maintenance will be borne by future taxpayers.

In part because it claimed a lack of authority to do so, the Commission failed to require waste-dump operators to establish funds for care after closure. Long-term maintenance is to be settled by a vague "arrangement"–which can be as simple as a lease–between the burial ground operator and the government agency which resumes ownership after closure.[21] Thus, once again, there is a serious potential for future taxpayers to be burdened by an inadequate financial arrangement.

High-level waste. The fission reaction in a nuclear reactor's core forms intensely radioactive byproducts which constitute the "high-level" waste in spent reactor fuel. The environmental and financial problems of this radioactive category are illustrated by the Nuclear Fuel Services plant at West Valley, New York, site of the first commercial attempt to "reprocess" spent reactor fuel to recover its residual fissionable material.

In June 1963, Governor Nelson Rockefeller broke ground for this complex with a declaration reflecting the optimism of the times: "We are launching a unique operation here today which I regard with pride as a symbol of imagination and foresight."[22] Late in 1971, after a five-year operating history that included overexposures of workers and excessive releases of radioactive material to the environment, the plant shut down, never to operate again.

Nuclear Fuel Services announced, in September 1976, that it was abandoning reprocessing as uneconomical. The company notified New York State that it wished to exercise provisions of contracts signed with the Rockefeller Administration, which allowed the company to turn over to the state responsibility for "perpetual care and maintenance" of 560,000 gallons of highly radioactive waste generated during the plant's operation. The state government, reluctant to accept the financial burden of caring for the waste, turned to Washington for assistance.

Four years later Congress instructed the Department of Energy to establish a project to solidify and stabilize the waste at West Valley–an operation estimated to take nine years and at least $400 million to complete. The federal government will pay 90 percent of the costs of the project; New York state taxpayers will fund the remaining 10 percent.[23] Nuclear Fuel Services, then a Getty Oil subsidiary, escaped with relatively minor payments for the waste that it produced. Then in July 1981, the Department of Energy

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added insult to taxpayer injury by letting a $140 million contract for waste management at West Valley to Westinghouse Electric Corporation—which manufactures the reactors that produce atomic waste.[24]

In the final days of 1982, the lame-duck Congress passed a Nuclear Waste Policy Act, which for the first time required the Department of Energy to collect fees from utility companies operating reactors, the funds to be applied to the federal government's costs of managing nuclear waste. It remains to be seen, however, whether the fees specified—one-tenth of a cent per kilowatt-hour generated—will prove sufficient for guarding high-level reactor waste for the thousands of years it will be active, while preventing the dispersal of radioactive material through the environment to the citizenry. Experts in Germany have estimated that charges 20 to 40 times those established in the Waste Policy Act may be necessary to fund the long-term management of reactor waste.[25]

Fair versus laissez-faire. While long-term costs from the nuclear fuel cycle probably cannot be accurately estimated, they will certainly be large. They are also inherently inflationary: the money necessary to manage radioactive byproducts will produce no new consumer goods, since the power that generated the byproducts will long since have been consumed.

An axiom which distinguishes a fair economic system from a laissez-faire one is that in the former, corporations will pay the bills for the economic externalities they produce. A corollary is that when the future costs of externalities are uncertain, efforts must be made to assess present corporations for all foreseen requirements, plus some contingency fund, rather than leave possible shortfalls to future generations.

The history of nuclear fuel cycle costs has been inconsistent with a fair economic system. When government agencies have attempted to estimate future costs, they have consistently erred in the industry's favor. Federal agencies have moved slowly to meet the financial challenges of the nuclear fuel cycle, and only when prodded by outside pressure. Even then, what regulations have been promulgated contain significant loopholes, more likely to burden present and future taxpayers than nuclear corporations.

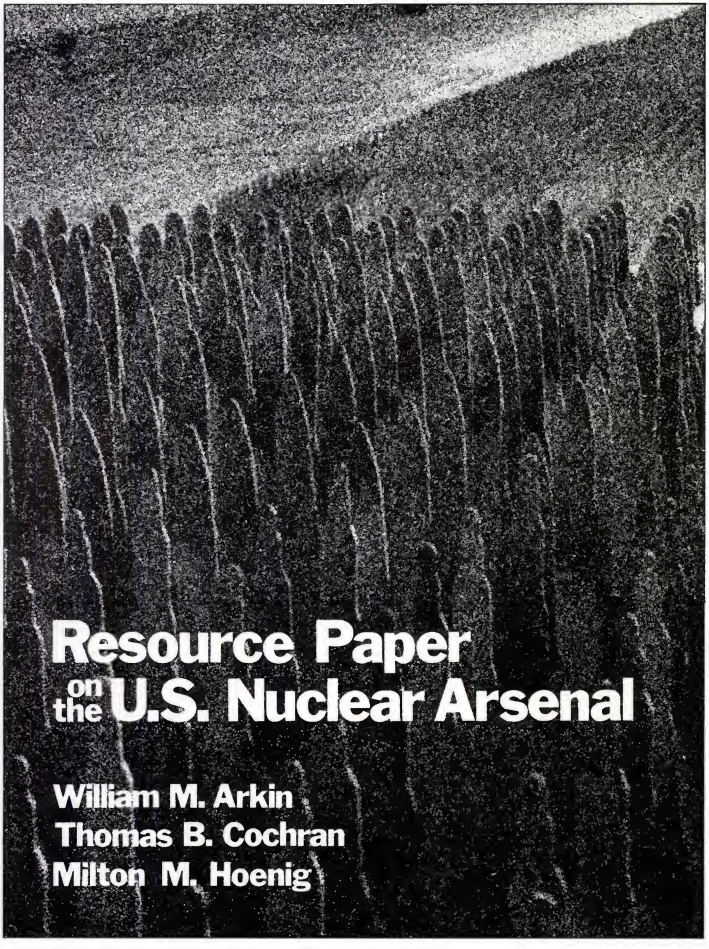
It is widely recognized that because of serious inherent economic problems, the atomic power industry, although heavily subsidized, is in a moribund state which is probably irreversible.

- Nuclear power, since it produces only electricity, cannot easily displace oil, which in the United States is predominantly consumed by automobiles and trucks.
- Because the electrical utility industry is egregiously overbuilt nationwide, nuclear power plants would not be needed even if they could save oil.
- The serious economic problems which the Three Mile Island accident—a relatively "small" nuclear power plant malfunction—have caused for General Public Utilities have ensured that utility executives will have serious second thoughts about nuclear investments.[26]

It thus becomes imperative that before the industry goes under, consumers must extract from it the funds that will pay far into the future for sound management of the industry's radioactive garbage. There are two options for addressing the problem: either regulatory bodies can require the industry to place funds in escrow now to meet these costs; or governments can evade the issue, leaving funding to chance and future generations.

The short history of nuclear fuel cycle operations proves the folly of the latter approach. It may be the illogical extension of Reaganomics to charge present and future taxpayers for the atomic industry's mismanagement and malfeasance. But it is neither sound regulation nor sound economics; and it certainly is not democracy. □

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Resource Paper on the U.S. Nuclear Arsenal

William M. Arkin
Thomas B. Cochran
Milton M. Hoenig

Since its inception the Bulletin of the Atomic Scientists *has sought to increase public knowledge of nuclear weapons issues. This supplement—a condensation and updating of the 340-page first volume of the authors'* Nuclear Weapons Databook*—continues that tradition. Published earlier this year under the auspices of the Natural Resources Defense Council, volume one of the* Databook *is a comprehensive and detailed compilation of U.S. nuclear forces and capabilities. (The second volume,* The U.S. Nuclear Weapons Production Complex, *is in preparation.) This condensed version is a concise reference work of nine sections: the Reagan Administration's nuclear weapons buildup; the current U.S. stockpile; the land-based missile force; the sea-based missile force; the strategic bomber force; nonstrategic nuclear forces on land; the Navy's non-strategic nuclear weapons; and weapons research and development. The authors conclude by outlining the future shape of U.S. nuclear forces; they note that the Reagan Administration does not appear to consider arms control a viable way of improving U.S. security.*

The Bulletin *acknowledges the support of the Ruth Mott Fund in the preparation of this supplement.*

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Resource Paper on the U.S. Nuclear Arsenal

by William M. Arkin, Thomas B. Cochran and Milton M. Hoenig

THE REAGAN ADMINISTRATION came into office with a goal of achieving nuclear superiority over the Soviet Union. The Administration's view was that the Soviets had outspent and outbuilt the United States during the 1970s, and that the U.S. nuclear arsenal was outdated, vulnerable and ineffective.

Administration officials believed that the restoration of America's strength required numerical superiority in warheads and delivery systems. The objective, however, was not limited to deterring attack. The new government's nuclear war strategy called for U.S. nuclear forces to "prevail" over the Soviet Union, "terminate" war on "terms favorable" to the United States, and emerge with more nuclear weapons than any potential "postwar" enemy.[1]

Weapons programs begun in the Carter Administration were quickly accelerated and development of new weapons was initiated. While ambitious buildup plans encountered political, technical and fiscal problems, the overall pace and direction of nuclear weapons acquisition set in motion three years ago continues.[2] Under current plans the number of warheads will grow from 25,000 to over 29,000 by the end of the decade. In the absence of significant arms control agreements, the size of the stockpile will further increase in the 1990s.

Public concern over this increase has had little real impact. The Administration has responded in part by claiming that the current "buildup" is not a buildup at all. They claim that the retirement of old weapons compensates for new production. Yet their own projections show at least a 13 percent increase in the number of warheads in the nuclear stockpile.[3] They further state that the number of warheads is at its lowest point in more than 15 years and that the total megatonnage is one-fourth of its peak level, implying that the U.S. bomber force of the early 1960s was more capable than today's force of ballistic missiles, bombers and cruise missiles.

Opposition in Congress has not slowed the nuclear weapons buildup, although there have been numerous changes in weapons priorities, schedules and levels of funding. The House of Representatives in 1983 voted for a "nuclear freeze" but later approved funds for almost all of the new nuclear weapons systems. While Congress has decided to delete or reduce funding for a number of new nuclear warheads, it has voted to fund the associated delivery systems in separate bills, with the single exception of the W-82 155-millimeter nuclear artillery shell. Since the delivery systems are being approved the eventual funding and production of warheads is inevitable.

The Administration is, in fact, building new warheads as fast as it can. The Administration has refurbished and expanded the Department of Energy's nuclear weapons production capability. Its production rate is now almost 1,500 new nuclear warheads per year, significantly higher than the rate of the mid-1970s.[4]

What really has limited the pace of the Administration's nuclear buildup has been generally overlooked: It is the size and structure of the nuclear weapons production complex. The pace is constrained chiefly by a combination of three factors: the overall capacity to work on warheads, the supply of materials and the complexity of new warheads.

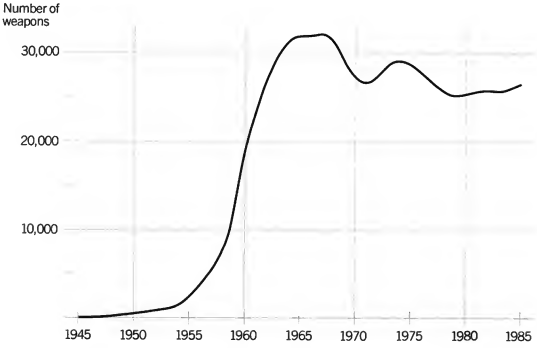
The total capacity of the production complex has been expanded to some 4,000 warheads per year, including new warheads (and inert test mock-ups), retirements, and modifications. Since most of the materials for new warheads come from the retirement of old warheads, a significant fraction of the total capacity must be allocated to retirements. Modifications to existing warheads—for example to improve their safety or reliability—must also be taken into account. In addition, "increased sophistication of the designs" of new warheads requires "greater plant and equipment investment, and significantly more production manhours."[5] Today, each new warhead requires unique production facilities. It takes about 48 months from start of construction of these special facilities until the first warhead is completed.

Seeking to remove the various currently existing physical constraints, the Reagan Administration has adopted, "as a matter of policy, [that] national security requirements, not arbitrary constraints for nuclear material availability and weapons fabrication capacity shall be the limiting factor in nuclear force structure."[6] To meet increased material needs, the Energy Department has almost doubled its annual rate of plutonium/tritium production since 1979. At the same time the objective of a five-ton "reserve" of plutonium was established.

The Administration has not been able to maintain a balance between retirements and new warhead production,

Fig. 1

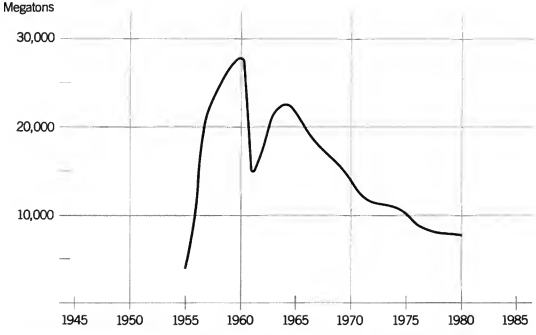
Number of U.S. warheads and bombs, 1945-1984



Based on Department of Defense statistics. For further information, see Cochran, Arkin, Hoenig, *Nuclear Weapons Databook*, 1 (Cambridge: Ballinger Publishing Company, 1984), p. 15.

Fig. 2

The U.S. nuclear stockpile: Yield in megatons, 1955-1980



Informational graphics: Michael Yanoff. Wayne E. Nail assisted in preparing the charts for publication.

Acronyms

AASM	advanced air-to-surface missile
ACM	advanced cruise missile
ALCM	air-launched cruise missile
ASALM	advanced strategic air-launched missile
ASROC	anti-submarine rocket
ASW	anti-submarine warfare
ATB	advanced technology bomber
CEP	circular error probability
CSRL	common strategic rotary launcher
DARPA	Defense Advanced Research Projects Agency
ER	enhanced radiation
ICBM	intercontinental ballistic missile
INC	insertable nuclear components
IOC	initial operational capability
JTACMS	Joint Tactical Missile System
MARV	maneuvering reentry vehicle
MIRV	multiple independently targeted reentry vehicle
NSNF	non-strategic nuclear forces
NWSM	Nuclear Weapons Stockpile Memorandum
PGRV	precision-guided reentry vehicle
SAM	surface-to-air missile
SLBM	submarine-launched ballistic missile
SLCM	sea-launched cruise missile
SRAM	short-range attack missile
SUBROC	submarine-launched rocket
TASM	tactical air-to-surface munition

and has thus not been able fully to achieve its goals.[7] For example, in 1981, it was decided to produce two new enhanced radiation (ER) warheads. The older fission warheads, however, were to be removed from Europe in order to recover their materials. But since the enhanced radiation warheads could not be sent to Europe, the Army refused to surrender the fission warheads. Until the production of new warheads peaks, in about 1987, these production constraints will continue to affect the pace of the nuclear buildup.

The stockpile today

TWENTY-SIX TYPES of nuclear warheads in 28 different delivery systems are currently deployed (Table 1). The number of warheads in the stockpile peaked in 1967 at just over 32,000, then dropped to about 27,000 by 1970. Increasing in the mid-1970s to about 29,000, the number then declined to 24,000 or 24,500 and remained there from the late 1970s to 1982. The largest number of warheads—over 30,000—were produced between 1955 and 1965 (Figure 1). Under current plans, between 1983 and 1993 about 21,000 new warheads will be added to the stockpile.

The Department of Energy plans to spend over $15 billion for nuclear weapons in fiscal years 1984 and 1985. Eight warhead types will be in full-scale production during this period:[8]

- B61–3/4 bomb for tactical air forces
- W76 Trident I warhead
- W79–1 enhanced radiation eight-inch artillery warhead
- W80–0 sea-launched cruise missile warhead
- W80–1 air-launched cruise missile warhead
- B83 "modern strategic bomb"
- W84 ground-launched cruise missile
- W85 Pershing II warhead.

The Department has four more warheads in advanced stages of development which it plans to start deploying in the 1980s. At least 15 additional warheads, in earlier stages of research and development, are planned for deployment in the 1990s (Table 2). The new weapons incorporate technological advances in lightweight materials, miniaturized electronics, safety, design, reliability, and guidance and fusing systems. Enhanced radiation warheads are replacing many small fission warheads, while versatile selectable-yield warheads are replacing older single-yield versions. New, lighter bombs, which can be delivered by planes at supersonic speeds from as low as 150 feet, are replacing older, heavier ones.

The "modernized," more flexible stockpile is influencing changes in the classification of nuclear weapons and in the plans for their use. Distinctions among the traditional categories of weapons—strategic, theater, tactical (or battlefield) and sea control—have become increasingly blurred. Weapons earmarked to destroy fixed targets according to predetermined plans are now being integrated into both strategic and theater scenarios. For instance, new intermediate-range land-based theater weapons, the Pershing II and ground-launched cruise missiles, have roles in the strategic war plan, while strategic systems such as the Poseidon and B-52 are assigned to theater targets. Strategic bombers are also being allocated for tactical targeting of enemy naval assets.

A fourth type of nuclear weaponry, the sea-launched cruise missile, is being added to the strategic "triad" of land-based intercontinental ballistic missiles (ICBMs), submarine-launched ballistic missiles (SLBMs) and bombers. These will become a part of the "strategic reserve force," a set of weapons meant to be withheld from initial nuclear exchanges.

Land-based missiles

THE LAND-BASED MISSILE force currently consists of 1,000 Minuteman missiles (450 Minuteman IIs and 550 Minuteman IIIs), armed with 2,100 warheads; and 34 single-warhead Titan II missiles. Four warhead types are deployed on land-based missiles, ranging from 170 kilotons to nine megatons in yield. The MX missile, labeled "Peacekeeper," is in flight testing. Its warhead is in "engineering development" where it is being prepared for initial production in fiscal 1985. The MX will carry ten W-87 MIRVed warheads, more than three times as many as carried by Minuteman III and each twice as accurate. The emplacement of 100 MX missiles in Minuteman III underground silos

Table 1. The U.S. nuclear stockpile (1984)[a]

Warhead/Weapon	*Year first deployed*	*Yield (kilotons)*	*User*[c]	*Number in stockpile*	*Status*
W25/Genie[b]	1957	2	AF, C	100	being retired
B28/bomb	1958	70–1,450	AF, MC, N, NATO	1,200	to be replaced by B61 and B83
W31/Nike Hercules[b]	1958	1–20	A, NATO	500	being withdrawn from Europe and retired
/Honest John[b]	1958	1–20	NATO	200	being withdrawn and retired
W33/8-inch artillery[b]	1956	1–12	A, MC, NATO	1,000	some being retired; to be replaced with W79
B43/bomb	1961	500–1,000	AF, MC, N, NATO	700	to be replaced by B83
W44/ASROC	1961	5–10	N	574	to be replaced by ASW Standoff Weapon/VLA
W45/Terrier	1956	1	N	100	to be replaced by Standard-2/W81
/Medium ADM[b]	1964	1–15	A, MC, NATO	350	to be retired
W48/155mm artillery	1963	0.1	A, MC, NATO	922	to be replaced by W82
W50/Pershing IA[b]	1962	60–400	A, NATO	280	U.S. warheads being replaced with W85
B53/strategic bomb[b]	1962	9,000	AF	50	to be replaced with B83
W53/Titan II[b]	1963	9,000	AF	50	being retired
W54/Special ADM	1964	.01–.1	A, MC, NATO	260	no planned replacement
W55/SUBROC	1965	5–10	N	285	to be replaced by ASW Standoff Weapon
W56/Minuteman II	1966	1,200	AF	480	to be retained at least until 2000
B57/bomb/depth bomb	1964	sub-20	AF, MC, N, NATO	3,100	to be replaced by B61 and ASW Standoff Weapon/NDB
B61/bomb	1968	50–345	AF, MC, N, NATO	2,600	in production, to replace certain B28, B43, B57
W62/MM III (Mk-12)	1970	170	AF	825	to be retained at least until 2000
W/68 Poseidon	1971	40	N	3,300	retirement planned from 1993 to 1999
W69/SRAM	1972	170	AF	1,140	to be replaced by Advance air-to-surface missile
W70/Lance	1972	1–100	A, NATO	1,282	to be replaced by Joint Tactical Missile System
W76/Trident I	1979	100	N	3,000	in production, 3,600 planned
W78/MM III (Mk-12A)	1979	335	AF	1,000	to be retained at least until 2000
W79/8-inch artillery	1981	1	A, MC	500	in production, 800 planned
W80/ALCM	1981	200	AF	1,100	in production, 1,700 planned
/SLCM	1984	5–150	N	50	in production, 758 planned
B83/bomb	1984	1,100	AF, N	200	in production, 2,500 planned, replaces B28, B43 and B53
W84/GLCM	1983	20–150	AF	100	in production, 500 planned
W85/Pershing II	1983	10–80	A	50	in production, approximately 150 planned
Total				**25,298**	

[a] Authors' estimates of stockpile breakdown of 26,000 weapons as of May 1984; not shown are weapons retained on inactive status (110 Sprint/Spartan warheads) and weapons awaiting dismantling, including some warheads for which the delivery systems were long ago retired.
[b] Weapons planned for partial or complete retirement in 1984–1990, as called for in present plans.
[c] AF: Air Force, A: Army, C: Canada, MC: Marine Corps, N: Navy, NATO: North Atlantic Treaty Organization members.

will begin in Nebraska and Wyoming in December 1986. The W-87 warhead is so designed that its "baseline" yield of 300 kilotons can be upgraded to 475 by changing fissile materials, depending on MX accuracy and the hardening of Soviet targets. The weight of the reentry vehicle, however, has its cost in terms of range and may result in some MX missiles carrying fewer than ten warheads, particularly if heavy penetration aids are adopted.

Deployment of at least 100 MXs now seems certain, and the long-term plan of the Joint Chiefs of Staff is reportedly to deploy 200.[9] The Reagan Administration halved the Carter Administration plan for 200 MXs, but it has added the new Small ICBM to its procurement list. With an initial operating capability planned for 1992–1993, Small ICBMs are envisioned as a complement to Minuteman and MX.[10]

In April 1983, the President's Commission on Strategic Forces recommended development of a small, single-warhead ICBM of about 30,000 pounds, to be widely dispersed in super-hardened silos, deep underground shelters or hardened mobile launchers.[11] Each of at least 1,000 missiles would carry one Mk-21 reentry vehicle, with either a W-87 MX or new warhead having a selectable yield from 100 to 500 kilotons.

The Air Force has been removing and dismantling approximately one Titan II missile every 45 days as part of a five-year retirement program begun in October 1982. By 1988, all Titans are to be decommissioned. Congress failed to fund replacement of 50 single-warhead Minuteman IIs with triple-warhead Minuteman IIIs in fiscal 1983.[12] Instead, the Minuteman II force will be upgraded with some accuracy improvements between 1986 and 1991.[13] Minuteman IIs and IIIs will probably remain deployed through the year 2000.

Sea-based systems

THE PRESENT FORCE of strategic ballistic-missile submarines includes four Trident and 31 Poseidon submarines, capable of firing 568 submarine-launched ballistic missiles and carrying 5,344 warheads. The Poseidons, constructed between 1960 and 1967, carry 16 submarine-launched ballistic missiles. Twelve Poseidon boats have been modified to carry the Trident I C4, and 19 carry older Poseidon C3 missiles. The new Ohio class (so-called Trident) submarine has 24 launch tubes and at present carries the Trident I.

Table 2. Nuclear warhead research and development

Weapon	*Phase FY85*	*Production begins*	*Current IOC*	*Number planned*[a]	*Status*
W-81 Standard-2	3/4	1987	1991	500	Terrier replacement, Phase 3 since September 1977
W-82 155mm artillery	3	—	—	(1,000)	W-48 replacement, cancelled in FY 1985 budget, Phase 3 since February 1978
W-87 MX	3/4	1985	1986	1,055	Phase 3 since FY 1981
ASWSOW submarine launched	2	1986	1990	300	SUBROC replacement, Phase 2 since FY 1980
ASWSOW vertical launch ASROC	2	1990s	1990s	300	ASROC replacement, Phase 2 since FY 1980
ASWSOW nuclear depth bomb	1/2	1990s	1990s	900	B-57 replacement, Phase 2 since FY 1980
Trident II	3	1986	1989	4,800	new high yield warhead
Joint tactical missile system	1	1988	1990s	1,000	formerly Corps Support Weapons System, Lance replacement
Advanced air-to-surface missile	2/3	1988	1990	1,600	formerly Advanced Strategic Air Launched Missile, SRAM replacement, Phase 1 in FY 1984
Small ICBM	1	1990	1992	1,000	formerly Advanced ICBM
Tactical air-to-surface munition	1	1990s	1990s	?	new tactical air-launched weapon
Air-to-air intercept missile	1/2	1990s	1990s	?	nuclear warhead for Phoenix, new in FY 1984
Supersonic anti-ship missile	1	1990s	1990s	?	new weapon
Advanced tactical air delivery weapon	—	—	—	?	in Phase 1 in FY 1983
Ballistic missile defense	—	?	?	?	in Phase 2 in FY 1984, formerly Sentry/LoADs, deferred in FY 1985
"3d Generation"	—	1990s	1990s	?	warheads possible in late 1990s
MARV	—	—	1990s	?	in Phase 2 in FY 1983
Advance cruise missile technology	—	—	—	?	in Phase 1 in FY 1983, cancelled in favor of W-80

[a] Numbers planned are authors' estimates as of May 1984.

Congress has authorized funds for 11 Trident submarines and the five-year shipbuilding program proposed by the Navy for fiscal 1985–1989 includes funds for construction of five more Tridents. The original service life of Poseidons, from 20 to 25 years, has been extended. Under current plans Poseidon submarines will be retired as they reach 30 years, between 1993 and 1999.

The Poseidon C3 and Trident I C4 missiles are MIRVed: The Poseidon can carry from six to 14 warheads, averaging about ten; the Trident I carries eight warheads. Trident I missiles have a greater range than the Poseidon and more than double the yield (from 40 to 100 kilotons) but have similar accuracy. The size of the Trident I was restricted to allow its deployment in smaller Poseidon submarine launch tubes. The new Trident II D5 missile, now planned for deployment on the ninth Trident submarine in late 1989, will be larger and more accurate, with greater range and a larger yield. By the late 1990s, at least 20 Trident submarines will be deployed, carrying Trident II missiles with eight warheads each, a minimum of 3,840 highly accurate warheads. Although the ultimate size of the Trident submarine force appears unsettled, recent statements indicate planning for an eventual force of as many as 25.

A high-yield warhead, reported at 475 kilotons, on a new reentry vehicle (Mk-5) with a 480-foot circular error probability will give the Trident II a hard-target kill capability comparable to the lower-yield but more accurate MX. Although the high-yield variant of the MX W-87 warhead was chosen as the developmental baseline for the Trident II, the Energy Department is working on a new warhead for the Trident.[14] In addition, a maneuvering reentry vehicle (Mk-600) is also being considered for the Trident II (as well as for the Small ICBM). The Mk-500 Evader MARV, which completed feasibility demonstrations on the Trident I, could also be converted for the Trident II, but at a greater loss of accuracy.

Strategic bomber force

THE STRATEGIC AIR COMMAND (SAC) operates over 326 strategic bombers, of which 241 B-52s and 56 FB-111s are in the active force; the remainder are designated for backup and training. The bomber force carries six types of nuclear bombs and two missiles: the short-range attack missile (SRAM) and the air-launched cruise missile (ALCM). The bombs have various weights, yields, accuracies and delivery profiles (Table 1).

The number and type of nuclear weapons in the bomber force result from a complex analysis of survivability, penetration and targeting objectives. B-52s carry from as few as 12 nuclear warheads (missiles and bombs) to as many as 26, depending on the nature of their targets and whether they are on alert. Overall some 5,400 warheads are available to the strategic bomber force.[15] Thirty percent of the bombers are currently loaded with some 900 to 1,000 nuclear warheads and are on constant 15-minute alert. On "generated" alerts some 2,000 bomber weapons are loaded.

Bombers can destroy hardened military targets more effectively than land-based or submarine-launched missiles can. The FB-111 currently achieves the best hard-target kill capability of any U.S. strategic weapons.[16] The purchase of at least 4,000 cruise missiles, including 1,739 ALCMs and about 2,400 advanced cruise missiles (ACMs), the new B-83 "modern strategic bomb" (initial deployment in 1984) and a replacement for the short-range attack missile will enhance this capability.[17]

Development of long-range ALCMs is moving ahead rapidly. Full-scale production of the first generation is already being abandoned in favor of an ACM. The advanced model will include increased range, greater use of electronic countermeasures and "reduced observables," new software and better "mission planning flexibility." It will use the W-80-1, the same 200-kiloton warhead that is on the ALCM.[18] An ACM warhead, under development in fiscal 1983, has been cancelled. The Defense Department did not request funds in fiscal 1984 for the ALCM, but Congress, doubting that the advanced missile would be available in 1986, added 240 ALCMs.[19]

A new intercontinental cruise missile with a 6,000–8,000-mile range is being developed under the Advanced Cruise Missile Technology Program of the Defense Advanced Research Projects Agency, right on the heels of ACM. The Program is investigating "unconventional design and launch modes" for future delivery vehicles, by increasing the range, payload and penetration capability of smaller missiles.[20] The new missile would be supersonic, unlike the current ALCM which goes 500 miles per hour. It would be smaller, incorporate Stealth techniques, and have sensors to evade defenses. A new terminal homing unit and navigational aids will improve accuracy, and newer technology will provide increased thrust and reduced fuel consumption.

The B-83 bomb, which entered production in 1983, will eventually replace older B-28, B-43 and B-53 bombs. This new 1.1 megaton-yield bomb allows the pilot to release the weapon at supersonic speeds, from as low as 150 feet, activating a parachute-type (drogue) retard and a time-delay fuse. When delivered at low altitudes, the accuracy of this "laydown" method is equal to or better than that of ICBMs. With its high yield, the B-83 will be able to destroy "hardened Soviet ICBM silo and launch complexes, command, control and communications installations, and nuclear storage sites."[21]

The Air Force also plans a new advanced air-to-surface missile (AASM) to replace the SRAM. The former grew out of the advanced strategic air-launched missile (ASALM), a 15-year-old project to develop a Mach-4 air-to-surface missile. AASM will have longer range, greater accuracy and higher yield than SRAM.[22] A nuclear warhead for this missile will enter engineering development in fiscal 1985. In part through the use of very high-speed integrated circuits, AASMs will also be smaller than SRAMs, allowing each bomber to carry more missiles.[23]

The adoption of ALCMs, new bombs and AASMs in the

bomber force will be significantly aided by deployment of the common strategic rotary launcher (CSRL). Each rotary launcher will be capable of carrying either eight ALCMs, SRAMs/AASMs, or bombs, or a mix of these weapons. This will increase the weapons capacity and flexibility of bombers. According to *Air Force Magazine,* CSRL will thus "give the B-52 flexibility in reconstituting for another mission after an ALCM strike."[24]

In addition to increasing their loads, the bombers are themselves in the midst of significant change and improvement. The last of 79 B-52D bombers were withdrawn in 1983, but B-52Gs continue to be modified to carry 12 ALCMs under their wings. (Plans to modify these bombers for internal carriage of eight ALCMs were cancelled.) Starting in 1985, newer B-52Hs, with projected lifespans past the year 2000, will be modified to carry 20 ALCMs both internally and externally.

The first of 100 planned B-1Bs will be deployed in September 1986. B-1Bs are designed to carry ALCMs, SRAMs, and B-61 and B-83 bombs. For standoff missions B-1Bs will carry 20 ALCMs; for penetration missions, 16 bombs and eight SRAMs, and for "shoot and penetrate" missions, eight ALCMs, four bombs and four SRAMs.[25] According to one report, Air Force officials want another 100 B-1s, designated B-1Cs, with further reduction in radar cross section. This would be an alternative to ending B-1 procurement before the advance technology bomber (Stealth) is proven.[26]

The advanced technology bomber (ATB), in development since the late 1970s, is scheduled to fly in December 1987, with an initial operating capability in 1993.[27] Its major feature will be its reduced radar cross section—close to zero, compared to one square meter for B-1B and 10 square meters for B-52s. Active (electronic) and passive (nonmetallic and absorbing materials) measures will decrease radar reflections and energy emissions from the aircraft. The Air Force will deploy some 100 to 150 ATBs under current plans.

Deployment of B-1Bs and ATBs will change the complexion of the entire bomber force. The B-52Gs will be converted to standoff bombers, carrying only ALCMs (no bombs), after deployment of the B-1B. The CSRL may also allow B-52Gs to carry internal bombs which could be retained for follow-on strikes after an ALCM attack. A 1983 Defense Resource Board decision to begin B-52G retirement in 1988 has been rescinded, and current plans are to begin B-52G retirement in the 1990s when ATBs are deployed.[28] FB-111 bombers will be transferred to the tactical inventory as ATBs are deployed. The B-52H force will continue as an ALCM carrier through the end of the century.

A fourth element, nuclear-armed sea-launched cruise missiles, is being added to strategic offensive forces beginning in June 1984. The nuclear-armed SLCMs, with a range in excess of 1,500 miles, are intended for deployment on attack submarines and surface ships; they will form part of a strategic reserve. Management and technical problems have plagued the SLCM program, and work on some conventional versions of the missile has been delayed; but this is not true of the nuclear land-attack version. Current plans are to deploy 758 nuclear versions, a change from earlier plans to deploy about 460 and then 1,000.

Table 3. Strategic nuclear forces (1984)[a]

Delivery System	*Launchers*	*Warheads/ launcher*	*Forces warheads*[b]	*Total warheads*[c]	*Yield (megatons)*	*Forces (megatons)*
Minuteman II	450	1	450	500	1.2	540.0
Minuteman III	550	3	1,650	1,825		429.0
Mk-12	(250)		(750)	(825)	.17	(127.5)
Mk-12A	(300)		(900)	(1,000)	.335	(301.5)
Titan II	34	1	34	50	9.0	306.0
Total ICBMs	*1,034*		*2,134*	*2,375*		*1,275.0*
Poseidon	304	10	3,040	3,500	.05	152.0
Trident I	288	8	2,304	3,000	.1	230.4
Total SLBMs	*592*		*5,344*	*6,500*		*382.4*
B-52G/H	264		3,192	—		
ALCM carriers	(90)	20–24	(1,800)	—	7.08–9.42	637.2–847.8
Non-ALCM carriers	(174)	8–16	(1,392)	—	4.68–16.0+	814.3–2,784+
FB-111	60	6	360	—	4.34	260.4
Total Bombers	*324*		*3,552*	*5,360*		*1,711.9–3,892.2*
Grand total	**1,950**		**11,030**	**14,235**		**3,369.3–5,549.6**

[a] Authors' estimates as of March 1984; numbers exclude sea-launched cruise missiles and Genie missiles.
[b] Force loadings refer to the nominal loading of the total force.
[c] Total warheads refers to all warheads in the stockpile, some of which are spares or extras.

Table 4. Non-strategic nuclear force warheads (1984)[a]

Weapon (warhead)	United States	Europe U.S. use	Europe NATO use	Deployment Pacific	Deployment At sea	Total
GLCM/Pershing II (W-84, W-85)	—	150	—	—	—	150
Bombs (B-28, B43, B-57, B-61)	1,210	1,415	320	135	720	3,800
Depth bombs (B-57)	560	130	60	100	45	895
Pershing IA (W-50)	—	180	100	—	—	280
Lance (W-70)	587	325	370	—	—	1,282
8-inch artillery (W-33, W-79)	500	505	430	65	—	1,500
155mm artillery (W-48)	160	592	140	30	—	922
Honest John (W-31)	—	—	200	—	—	200
Nike Hercules (W-31)	—	110	390	—	—	500
Atomic demolition munitions (W-45, W-54)	220	370	—	20	—	610
Terrier (W-45)	64	—	—	—	36	100
ASROC (W-44)	224	—	—	—	350	574
SUBROC (W-55)	110	—	—	—	175	285
Total	3,635	3,777	2,010	350	1,326	11,098

[a] Authors' estimates as of May 1984.

In strategic defensive forces only one nuclear weapon—the Genie air-to-air rocket—is currently deployed. But its primary carrier, the F-106, will soon retire, to be replaced by the F-15. The Air Force will therefore take the Genie out of service and has no plans to replace it. One advanced research and development project under the Defense Advanced Research Projects Agency—the ballistic intercept missile—will examine advanced designs for "a ballistic weapon that could kill inflight bombers."[29]

The standard tallies of strategic warheads, for "balance" assessments or arms control, do not take into consideration the total number of warheads in the stockpile, or even those available for warfare (Table 3). The Defense Department uses many different designations for counting warheads—day-to-day alert, generated alert, maximum alert, force loadings—that include only certain weapons. It is commonly assumed, for instance, that some 50 to 60 percent of strategic submarine warheads are "on station" at any time, ready to deliver some 2,500 warheads. In fact, while 50 to 60 percent are at sea, only 30 percent are counted as being on "day-to-day" alert, with the remainder (in transit or training) on "modified alert."

Bomber counting is even more confusing. Some 30 percent are on "day-to-day" alert, but the number of weapons they carry is only 900, far less than their capacity, even though there are some 5,400 missiles and bombs in the bomber force. "Force loadings," the number of weapons the bombers could carry under theoretical conditions (as opposed to actual plans), include some 3,000 weapons. But they exclude spares as well as "weapons reserved for restrike (reserves) and weapons on inactive status."[30]

Non-strategic nuclear forces

HALF THE NUCLEAR warheads in the stockpile are in the non-strategic nuclear forces (NSNF). These have only begun to receive the attention accorded to strategic nuclear forces, but they are subject to a wider variety of political influences. Most important are the requirements of NATO and the politics of warhead deployments outside the United States.[31]

As with strategic forces, aircraft deliver most of the warheads in non-strategic forces. Four of the six nuclear bomb types—some 4,000 bombs—are assigned to tactical aircraft in the non-strategic nuclear forces (Table 4). Fifteen U.S. and NATO aircraft types are currently modified and "certified" to carry nuclear weapons; 12 of the 15 are land-attack fighter bombers and three are anti-submarine planes. Eight types are operated by NATO allies, including three foreign-built aircraft.

The tactical nuclear bomb stockpile has been significantly improved over the past 15 years. It now contains predominantly newer B-57 and B-61 versions, both of which have selectable yields, weigh under 1,000 pounds and are much more versatile than the heavier, single-yield bombs they replaced. The B-61 has been in continual production since 1968, and has undergone six modifications. The Energy Department fiscal 1985 budget requests contain plans to accelerate new modifications of the B-61 (6, 7 and 8).[32]

Five new nuclear weapons for tactical aircraft are in research and development. A "standoff nuclear depth bomb" is undergoing a feasibility study and is slated to replace the B-57 in the 1990s. A program for a 10-kiloton standoff tactical air-to-surface munition (TASM), with terminal guidance for use against battlefield targets, is being explored. The Joint Tactical Missile System (JTACMS) development program (discussed below) of the Air Force and Army is investigating second-echelon strike missiles that could deliver nuclear warheads. In fiscal 1983, the Joint Chiefs of Staff also reported a study to "assess the military utility

of a standoff, air delivered earth penetrator, nuclear weapon system" and a nuclear armed "Advanced Air Delivered Tactical Weapon," which may be the same weapon.[33]

Army missile warheads make up the second largest group of non-strategic nuclear weapons. There are some 2,245 warheads for four different missiles (1,880 in Europe). The newest nuclear missile is the Pershing II, which began production in 1982 and was first deployed in West Germany in December 1983. All 108 U.S. Pershing IA launchers will be converted for the new Pershing II missile, but the Army will deploy some 150 Pershing II warheads. Plans to build additional warheads to provide the launchers with a reload missile have been cancelled for political reasons and warhead production has been "adjusted."[34]

The yield of the W-85 warhead on the Pershing II is selectable up to 80 kilotons. Its accuracy (30-meter CEP) makes it able to destroy any target within its 1,800-kilometer range. Because of production and testing problems full deployment of the Pershing II has been delayed until 1988. The West German government still has to decide on the future of its own Pershing IAs (with 72 launchers), which carry the much less accurate, higher yield W-50 warhead.

The Army has three types of short-range missiles in use: the Lance, Honest John and Nike Hercules. One hundred Lance launchers are deployed in the U.S. Army and seven NATO armies; they are equipped with 1,280 nuclear warheads, 695 of them in Europe. There are two basic warhead types: fission and enhanced radiation. The original fission warheads (the W-70 Mods 1 and 2) have a selectable yield ranging from one to 100 kilotons. The newer enhanced radiation warhead (the W-70 Mod 3), produced between 1981 and 1983, has a yield in the one-to-10 kiloton range. Since these warheads cannot be deployed to Europe, the 380 W-70 Mod 3 warheads are stored in the United States.

A follow-on to the Lance is a dual-capable missile with longer range and greater accuracy. Called the Joint Tactical Missile System (formerly Corps Support Weapon System), it has been in development since 1981. Members of Congress have criticized the nuclear-armed version as incompatible with future conventional capabilities and the "Air-Land battle" doctrine. Initial warhead studies include both fission and enhanced radiation versions.

Greece and Turkey were the only NATO nuclear allies who did not purchase the Lance missile. They still use the Honest John, which was first deployed in 1958 and has a single-yield 20-kiloton nuclear warhead. Its short range and serious operational problems make it the least desirable of any nuclear weapons deployed.[35] Defense Department officials have testified before Congress that they intend to withdraw the 198 Honest John (W-31) warheads from Europe. This would leave the Greek and Turkish armies with no nuclear system other than artillery, which the military considers politically unwise.[36] Nonetheless, the Honest Johns are "dual-capable systems that may no longer be as effective in the conventional mode" and will not able to operate reliably until a Lance replacement is deployed.[37]

Dual-capable Nike Hercules surface-to-air missiles, which are of the same generation as the Honest John and use the same warhead, are also being withdrawn. Before withdrawal began, in 1981, there were some 685 warheads in Europe. Since then, Army officials have stated that the United States has withdrawn at least seven of its 16 batteries (nine launchers each). The nuclear roles of German, Greek and Dutch Nike Hercules have been scaled back, and Belgium has initiated retirement in anticipation of the conventional Patriot, to replace the nuclear missiles starting in late 1984.[38] By 1985, all 144 U.S. launchers will have been withdrawn, and several NATO allies have begun retirement of nuclear warheads.

A third of the nuclear warheads used by Army and Marine Corps ground forces are nuclear artillery shells, consisting of two types. The larger eight-inch shells include both the W-33, the oldest nuclear weapon in the U.S. arsenal, and the W-79, the new enhanced radiation version. According to the Senate Appropriations Committee, significant safety concerns have been voiced about the W-33, but the Army insists that retirement must be linked with deployment of the W-79 to Europe.[39] Since this is not politically feasible at this time, retirement of W-33s is being held up. Nonetheless, 198 W-33s stored in the United States are being retired as new W-79s are built and the Army plans to reduce the stockpile of 940 W-33s in Europe.[40] Production of the W-79, which began in 1981, has slowed down for technical reasons.

About 925 of the smaller 155-millimeter (six-inch) W-48 nuclear artillery shells are deployed; their controversial enhanced radiation replacement (W-82) has been deferred. After Congress cut funds in fiscal 1983 and 1984, the Energy Department did not request money in fiscal 1985 to complete production facilities for the new warhead for three reasons: a cost of some $3.5 billion to produce 1,000 warheads; existing demands on a production complex operating at full capacity; excessive requirements for materials (particularly tritium). Since Army and NATO officials still say they need to replace the W-48, future requests for the W-82, rebuilt as a less expensive fission weapon, are expected.

Finally, there are some 600 atomic demolition munitions of two types in the nuclear stockpile. The larger one, the medium atomic demolition munition, "has limited utility and will be phased out of the NATO inventory," according to Defense officials.[41] Military planners still consider the smaller type, the special atomic demolition munition, to have some usefulness: it can be carried by commandos behind enemy lines, and it has an extremely low yield. The Army will retain it "until the end of its useful stockpile lifetime."[42]

Naval nuclear weapons

THE NAVY'S NON-STRATEGIC nuclear weapons include 2,750 land-attack, anti-submarine and anti-air weapons. About 1,600 are the aircraft-delivered land-attack and depth bombs discussed above. All 12 operational aircraft

carriers carry nuclear weapons. Some 700 nuclear bombs are "afloat" on the five or six aircraft carriers at sea at any time.

Nuclear-armed land-attack versions of the Tomahawk sea-launched cruise missile (SLCM) will be deployed in June 1984. The nuclear SLCM, armed with the 150-kiloton W-80-0 warhead, will be deployed initially on recommissioned battleships and attack submarines and eventually on a wide variety of surface ships and attack submarines fitted with the vertical launching system.

In all, there are 1,750 nuclear warheads for anti-submarine warfare (ASW), including 900 B-57 nuclear depth bombs, 575 ship-launched ASROC missiles (W-44) and 285 submarine-launched SUBROCs (W-55). The nuclear depth bombs are used by five different ASW planes—three land-based and two carrier-based. Britain, Italy and the Netherlands have ASW aircraft (Nimrods, Atlantiques and P-3 Orions) which are certified to carry U.S. nuclear depth bombs. Replacements for all three ASW weapons are in development, under the ASW Stand-off Weapon program. Programs for individual warheads for a new submarine weapon, a new vertical ASROC and a nuclear depth bomb are being initiated.

The Navy has one nuclear surface-to-air missile (SAM), the Terrier, for which there are 100 W-45-3 warheads. Nuclear Terriers are now on 31 cruisers and destroyers, and possibly three aircraft carriers. The next generation—long-range, nuclear SAM—is the Standard-2, slated to enter production in fiscal 1987. The nuclear version of the Standard-2, designated SM-2(N), will carry the W-81 fission warhead, now in Phase 3 of its development. Whether to develop a fission (as opposed to enhanced radiation) warhead has been in question by some in Congress, who cite the dangers of nuclear explosions to the launching ships.

Two other nuclear systems are under consideration for future air defense of naval forces. In 1982, the Defense Department revealed the existence of a feasibility study for a nuclear warhead for the Phoenix air-to-air missile, to be used for long-range defense of aircraft carriers against cruise missile attacks. The Navy is also working on a much longer-range anti-air missile, which could be fired from the vertical launching system to extend further the protection of aircraft carriers. The Martin Marietta advanced strategic air-launched missile (ASALM), previously in competition to replace the SRAM on bombers, has been offered as a potential "outer air battle missile." The Navy's Outer Air Battle Program is the umbrella under which SM-2(N) and Phoenix nuclear programs are justified.

Table 5. Deliverable strategic warhead projections (1984–2000)

	1984	*1985*	*1986*
Land-based (ICBMs)[a]			
Titan II	34	22	10
Minuteman II	450	450	450
Minuteman III			
missiles	550	550	540
warheads	1,650	1,650	1,620
MX			
missiles	—	—	10
warheads	—	—	100
Small ICBM	—	—	—
Total land-based ICBM forces			
missiles	1,034	1,022	1,010
warheads	2,134	2,122	2,180
Sea-based (SLBMs)[a]			
Poseidon			
missiles	304	304	304
warheads	3,040	3,040	3,040
Trident I			
missiles	288	336	360
warheads	2,304	2,688	2,880
Trident II			
missiles	—	—	—
warheads	—	—	—
Total sea-based SLBM forces			
missiles	592	640	664
warheads	5,344	5,728	5,920
Air-based[a]			
Bombers			
B-52G/H	264	264	264
FB-111	60	60	60
B-1B	—	—	20
ATB	—	—	—
Total bombers	324	324	344
Weapons			
Bombs	3,250	3,250	3,250
SRAM/AASM	1,140	1,140	1,140
ALCM/ACM	1,100	1,190	1,430
Total air-based weapons	5,490	5,580	5,820
Total warheads	12,968	13,430	13,920

[a]ICBM and SLBM projections include force loadings; bomber weapons include all weapons.

Research and development

IN ADDITION TO SPECIFIC development of nuclear weapons, the laboratories of the Energy and Defense Departments are actively engaged in research leading to future weapons:

• *"Third generation" nuclear weapons.* Approximately $300 million will be spent in fiscal 1985 on development of these weapons, which gained additional support in the Reagan Administration's new Strategic Defense Initiatives. They emphasize "tailored weapons effects" and "single out some particular type of damage, for example, destruction of electronic components" by electromagnetic pulse (EMP) weapons.[43] The key projects in this area are in directed-energy weapons—which direct a fraction of the energy from a nuclear explosion into one or more narrow beams—such as

1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
—	—	—	—	—	—	—	—	—	—	—	—	—	—
450	450	450	450	450	450	450	450	450	450	450	450	450	450
516	480	450	450	450	450	450	450	450	450	450	450	450	450
1,548	1,440	1,350	1,350	1,350	1,350	1,350	1,350	1,350	1,350	1,350	1,350	1,350	1,350
34	70	100	100	100	100	100	100	100	100	100	100	100	100
340	700	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000
—	—	—	—	—	—	20	200	500	800	1,000	1,000	1,000	1,000
1,000	1,000	1,000	1,000	1,000	1,000	1,020	1,200	1,500	1,800	2,000	2,000	2,000	2,000
2,338	2,590	2,800	2,800	2,800	2,800	2,820	3,000	3,300	3,600	3,800	3,800	3,800	3,800
304	304	304	304	304	304	288	224	160	96	64	32	—	—
3,040	3,040	3,040	3,040	3,040	3,040	2,880	2,240	1,600	960	640	320	—	—
384	384	384	384	360	336	312	240	216	176	120	32	16	—
3,072	3,072	3,072	3,072	2,880	2,688	2,496	1,920	1,728	1,408	960	256	128	—
—	—	24	72	120	168	216	264	312	360	408	456	480	504
—	—	192	576	960	1,344	1,728	2,112	2,496	2,880	3,264	3,648	3,840	4,032
688	688	712	760	784	808	816	728	688	632	592	520	496	504
6,112	6,112	6,304	6,688	6,880	7,072	7,104	6,272	5,824	5,248	4,864	4,224	3,968	4,032
264	264	264	264	264	264	264	234	174	114	96	96	96	96
60	60	60	60	60	60	60	30	—	—	—	—	—	—
60	90	100	100	100	100	100	100	100	100	100	100	100	100
—	—	—	—	—	—	15	50	80	110	132	132	132	132
384	414	424	424	424	424	439	414	354	324	328	328	328	328
3,350	3,450	3,550	3,650	3,750	3,750	3,850	3,950	3,600	3,300	3,000	2,400	1,800	1,200
1,140	1,140	1,140	1,140	1,140	1,020	820	440	660	1,100	1,540	1,980	2,420	2,800
1,739	1,739	1,739	1,739	1,859	2,099	2,339	2,579	2,819	3,059	3,299	3,539	3,779	4,019
6,629	6,329	6,629	6,529	6,749	6,869	7,009	6,969	7,079	7,459	7,839	7,919	7,999	8,019
14,679	15,031	15,533	16,017	16,429	16,741	16,933	16,241	16,203	16,307	16,503	15,943	15,767	15,851

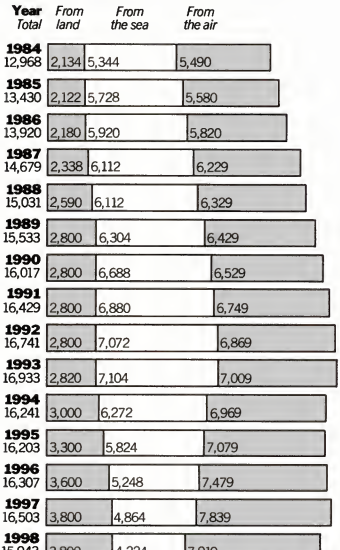
the nuclear-pumped X-ray laser and microwave generator.[44]

• *Advanced warhead technology.* Research in "compact implosion systems," "lesser weight, smaller diameter" warheads, and high yield-to-weight/volume warheads is going on to improve the current fission and fission-fusion generation of warheads.[45] Also, "modern, small diameter devices for NATO artillery . . . weapons with some intelligence through use of microprocessors . . . [and] smaller and lighter systems which satisfy more stringent requirements" are under development at the laboratories.[46]

• *Insertable nuclear components (INC).* There is a continuing research program, begun over ten years ago, to develop a generic warhead design that could be easily clipped into a dual-capable weapon. These components could be particularly useful aboard submarines where space is limited. The Navy is looking into the feasibility of these designs.[47]

Fig. 3

Strategic warhead count, projected 1984-2000



Based on Department of Defense statistics.

• *Anti-ballistic missile warhead.* Development of a nuclear "Sentry" low-altitude ABM missile "has been scrapped for the moment" in favor of third generation warhead research (under the Strategic Defense Initiatives). But quick development of an ABM system remains a planning option.[48] Sentry was a part of accelerated ABM research instituted in the October 1981 Strategic Modernization Program, but production plans were cancelled in February 1983. In 1983, the Energy Department stated that there were nine candidates for a nuclear ABM design.

• *Maneuvering reentry vehicles (MARV).* Development of advanced MARVs and precision-guided reentry vehicles (PGRVs) began in fiscal 1976. These have had more attention since the Scowcroft Commission's recommendation to increase development of advanced reentry vehicles and "penetration aids."

Conclusion

As MIGHT BE EXPECTED, many of the early Administration proposals for "quick fixes" to strategic forces have been abandoned: three Trident submarines every two years, Minuteman redeployment in multiple protective structures, expanded Trident I deployment on Poseidon submarines, or sea-launched cruise missiles on old Polaris submarines. To the contrary, the Administration is withdrawing old weapons such as B-52Ds, Titan IIs and Polaris submarines on the rationale that they are no longer cost effective.[49]

Although new weapons introduced by the Administration have been portrayed as part of carefully thought out, comprehensive packages, such as the October 1981 Strategic Modernization Program, the Scowcroft Commission and the Nuclear Weapons Employment and Acquisition Master Plan, there is no consensus either on the need for individual weapons or on the scope of grand schemes. The packages are often for public relations purposes—to find a rationale and build a consensus for weapon systems that have gotten into political trouble.

The many changes in plans for nuclear weapons development and acquisition make clear that, aside from a vision of superiority, there is no coherent plan for the future of the U.S. nuclear arsenal. The last three years have witnessed the following alterations:

• A reduction in the number of planned MX missile warheads from 2,000 to 1,000;

• The addition of Small ICBMs and B-1Bs to strategic force plans, with the advanced technology (Stealth) bomber development stretched;

• an increase from 15 to 20 or 25 in the number of Trident submarines to be acquired, with plans to backfit the ninth rather than the thirteenth submarine with the Trident II, leading to its deployment in 1989 even if the final warhead is not chosen;

• The addition of 1,200 W-70-3 Lance and W-79 eight-inch enhanced radiation warheads;

• an increase in plans for 758 rather than 460 (and previously 1,000) W-80-0 SLCM warheads;

• A decrease to 1,739 rather than 3,394 W-80-1 ALCM warheads programmed, with a shift to the ACM in the late 1980s;

• A decision to shift from normal fission to enhanced radiation design for 1,000 W-82 155-millimeter warheads, followed by cancellation of the program in fiscal 1985;

• Slowing down, changing or cancelling a number of programs such as the Standard-2, anti-submarine warfare stand-off weapon, and Sentry.

The Administration's objective of building up nuclear forces is nonetheless being achieved, albeit at a slower pace and with a different mix of weapons than were projected in 1980. The buildup will result in smaller weapons, greater accuracy and higher yield-to-weight ratios. The larger and fundamentally different arsenal will contain weapons far more capable than their predecessors. A larger proportion of the weapons will be deliverable through innovations in MIRVs, selectable yields and smaller sizes. The total yield of the stockpile, now in the range of 5 to 6 billion tons (down from a peak of some 27 to 28 billion tons), will increase as weapons with greater counterforce capability are introduced (Figures 1 and 2).[50]

The Administration's buildup is moving forward irrespective of existing and proposed arms control limitations (Table 5 and Figure 3). The Administration does not view arms control as a practical means to improve U.S. security. "Even if our best efforts at arms control succeed," said Richard Wagner, assistant to the secretary of defense for atomic energy, "we are going to need new nuclear weapon designs in the nineties and beyond."[51] As to whether the Small ICBM violates the SALT II agreement to develop only one new ICBM, Secretary of State George Shultz told the Senate Armed Services Committee, "On our side the new missile would be the Peacekeeper, but that treaty, even if it had been ratified, would have expired at the end of 1985."[52] If arms control didn't exist, it is hard to imagine how the existing weapons acquisition process would be any different. □

1. The Defense Guidance for fiscal 1984 was described in detail in Richard Halloran, "Pentagon Draws Up First Strategy for Fighting a Long Nuclear War," *New York Times* (May 30, 1982), p. 1.

2. Nuclear weapons acquisition plans are determined through a complex bargaining process which begins and ends in the federal bureaucracy. Every year, the President approves a joint Department of Defense/Department of Energy Nuclear Weapons Stockpile Memorandum (NWSM), which specifies nuclear warhead research and development, production, modifications and retirement for the next five years, and projections for 15 years. The Memorandum theoretically takes account of strategic and theater plans, new weapons, the retirement of obsolete weapons and arms control initiatives. These requirements are then translated into budgets, which match resources to plans. Only then does Congress act. It can approve, disapprove or modify the requests. An example of how Congress can indirectly affect the production cycle is seen in U.S. Congress, Senate Appropriations Committee, FY 1984 Energy and Water Development Appropriations, Hearings, Part 2 (hereafter referred to as SAC, FY 1984 EWDA, Part 2), p. 1,187.

3. U.S. Congress, House Armed Services Committee, FY 1984 Atomic Energy Defense Activities (hereafter referred to as HASC, FY 1984 AEDA), p. 19.

4. Office of the Assistant to the Secretary of Defense (Atomic Energy) (hereafter OATSD(AE)), Department of Defense, The Nuclear Weapons Production and RDT&E Complex—Energy Department Support of Defense Department Requirements (Dec. 1982), p. 1; see also SAC, FY 1984 EWDA, Part 2, p. 1,088.

5. The Energy Department has also admitted technical problems with some of its warheads; HASC, FY 1984 AEDA, p. 11; see also OATSD(AE), *op. cit.*, p. 2.

6. Approval Directive for the 1983–1988 NWSM, quoted in affidavit of Herman E. Roser (May 19, 1983), NRDC vs. William A. Vaughn, et. al.

7. SAC, FY 1984 EWDA, Part 2, pp. 1,155, 1,159.

8. SAC, FY 1984 EWDA, Part 2, p. 1,087.

9. George C. Wilson, "Memo Contradicts Reagan on MX Numbers," *Washington Post* (July 2, 1983); it is likely that 150 MXs would be deployed, given that about 150 of the existing Minuteman silos are deep enough to accommodate the MX; U.S. Congress, House Appropriations Committee, FY 1984 Department of Defense Appropriations, Hearings, Part 8, p. 158 (hereafter referred to as HAC, FY 1984 DOD).

10. HAC, FY 1984 DOD, Part 8, p. 125.

11. Defense Department, ICBM Modernization Program Annual Progress Report to the Committees on Armed Services of the Senate and House of Representatives (Jan. 13, 1984).

12. U.S. Congress, Senate Armed Services Committee, FY 1984 Department of Defense Authorizations for Appropriations, Hearings, Part 1, p. 310.

13. House Armed Services Committee, FY 1984 Department of Defense Authorizations for Appropriations, Hearings, Part 2 (hereafter referred to as HASC, FY 1984 DOD), p. 1,008.

14. In 1983, the Director of Los Alamos Laboratory stated that the laboratory had completed development of a high-yield Trident II warhead; SASC, FY 1984 DOE, p. 91.

15. Senate Armed Services Committee, MX Missile Basing System and Related Issues, Hearings, 98th Congress, 1st Session, p. 233.

16. HASC, FY 1984 DOD, Part 5, p. 431.

17. HAC, FY 1984 DOD, Part 8, p. 48.

18. HASC, FY 1984 AEDA, p. 126; SAC, FY 1984 EWDA, Part 2, p. 1,187.

19. SASC, FY 1984 DOE, p. 28.

20. DARPA, FY 1984 Research and Development Program, A Summary Description (April 1983), pp. 3–4.

21. Arms Control and Disarmament Agency, FY 1984 Arms Control Impact Statements, p. 70.

22. HASC, FY 1984 AEDA, p. 126.

23. "USAF Nears Air-to-Surface Missile Start," *Aviation Week & Space Technology* (Feb. 20, 1984), pp. 29–30.

24. John T. Correll, "Deterrence Today," *Air Force Magazine* (Feb. 1984), p. 43.

25. U.S. Congress, Senate Armed Services Committee, Strategic Modernization Programs, Hearings, 1981, pp. 91–92.

26. "Stealthy B-1," *Aviation Week & Space Technology* (Feb. 20, 1984), p. 15.

27. *Ibid.*

28. John T. Correll, *op. cit.*; *Air Force Magazine* (March 1984), p. 28.

29. DARPA, *op. cit.*, pp. 10–11.

30. Arms Control and Disarmament Agency, FY 1979 Arms Control Impact Statements, p. 31.

31. SAC, FY 1984 EWDA, Part 2, p. 1,155.

32. Department of Energy, Congressional Budget Request, FY 1985, Vol. 1: Atomic Energy Defense Activities (Feb. 1984), pp. 241–44.

33. Office of the Secretary of Defense, Justification of Estimates for FY 1984, submitted to Congress, Jan. 1983, p. 29.

34. HASC, FY 1984 AEDA, p. 31.

35. One DOD official referred to them as "the essentially unusable Honest Johns;" SAC, FY 1984 EWDA, Part 2, p. 1,215.

36. SAC, FY 1984 EWDA, Part 2, p. 1,155.

37. *Ibid.*, p. 1,174.

38. HASC, FY 1984 DOD, Part 3, p. 679.

39. SAC, *loc. cit.*, p. 1,174.

40. *Ibid.*

41. SAC, *loc. cit.*, p. 1,188.

42. *Ibid.*

43. HASC, FY 1984 AEDA, p. 27.

44. *Ibid.*, p. 86.

45. SAC, *loc. cit.*, p. 1,176.

46. DOE, FY 1985 Justification, p. 70.

47. Department of the Navy RDT&E Descriptive Summary, FY 1984, p. 703.

48. SASC, FY 1984 DOE, p. 28.

49. SASC, MX Missile Basing, *op. cit.*, pp. 180, 218, 498. Though the Administration justifies new systems because of "dire" conditions, routine retirements will continue. General Charles Gabriel, Chief of Staff of the Air Force, revealed the prevailing pattern of policy: "If we get the MX and the other systems and . . . find the Minuteman is not going to be worth the expense, we will phase it out."

50. Yield estimates reflect uncertainties about individual warheads, particularly about bombs (SASC, Strategic Force Modernization, *op. cit.*, p. 80). MX triples the yield of Minuteman III. Trident II, when deployed on 20 submarines, will have the explosive power of approximately 2,000 megatons, six times the strategic submarine megatonnage today.

51. HASC, FY 1984 AEDA, p. 26.

52. SASC, MX Missile Basing, *op. cit.*, pp. 110, 204.

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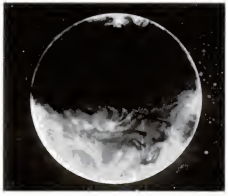
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The history of antisatellite weapons reveals several missed opportunities to limit their development. The superpowers now may face the last chance to control these destabilizing weapons.

ASAT arms control: still possible

by Raymond L. Garthoff

IT IS NOT YET TOO LATE to serve our true security interests by negotiating a ban, or at least sharp limitations, on testing and deployment of antisatellite (ASAT) systems. But time is running out. And although the Soviet leaders appear ready to discuss such an agreement, the Reagan Administration is at best highly reluctant.

Obviously, negotiations would be required to determine whether agreement on mutually acceptable terms could be reached, and there would be thorny verification issues. But while the Soviet leaders have been signalling their readiness to negotiate, the Reagan Administration has not. The issue, nonetheless, remains one on which a consensus in support of arms control may yet emerge. Along with the clear and present danger of a new arms race in this field, there is also a clear and present opportunity.

One aspect of this issue which has received almost no attention is the past record; yet it is instructive. How many realize that:

- the United States had an operational ASAT system deployed over 20 years ago, long before the Soviet Union did;
- the Soviet Union was led to pursue its ASAT tests at least in part because of the American lead;
- the United States first proposed (in 1977), then delayed (until 1978), and finally discontinued (in 1979) ASAT negotiations with the Soviet Union;
- the Soviet Union unilaterally observed a moratorium on ASAT tests throughout the period of negotiations;
- not only was a complete ASAT ban probably attainable in 1969–1972, during the SALT I negotiations, but it could have contributed to agreement then on a complete ban on ABM testing and deployment. Let us look back at a few pages in ASAT history.

The Carter Administration very early in its term proposed ASAT arms-control negotiation, as well as confirmed a last-minute initiative by the outgoing Ford Administration to launch an ASAT development program. One reason for the Ford Administration's action, and for its confirmation by the Carter Administration, was a renewal by the Soviet Union of a series of tests of a satellite ASAT interceptor in 1976, after nearly a five-year hiatus. The first test since December 1971 occurred on February 16, 1976, and eight more followed over the next two years.

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When the Carter Administration proposed ASAT arms-control talks to the Soviet leaders in March 1977, they readily agreed. The Administration, however, then found that it needed a year to develop an arms-control position *and* to work out an ASAT research and development program, which it wanted to pursue in tandem. By September an interim decision had been taken, establishing a "two-track" approach—confirming unilateral development, and conducting parallel talks with Moscow on possible ASAT limitation.

At the time the United States launched its own research and development program, the Soviets were deemed to have a marginal but operational capability, publicly disclosed by Secretary of Defense Harold Brown in October 1977. Accordingly, the first meeting with the Soviets did not take place until June 1978 in Helsinki, followed by two other meetings in Bern early in 1979 and in Vienna in April to June 1979. A fourth meeting was never held because the Carter Administration decided—unwisely, in my judgment—as part of its retaliation for the Soviet occupation of Afghanistan not to continue the talks.

In fact, even before Afghanistan, a split had developed in Washington between those who wanted an ASAT agreement and those who did not. The Administration also was led to be more cautious on the ASAT talks because of the difficult Senate debate on ratification of SALT II. The decision not to resume the negotiations was facilitated, more than caused, by the post-Afghanistan curtailment of contacts.

While the ASAT talks—including an American attempt to get an interim testing moratorium agreement in time for the June 1979 summit—had not yet succeeded, they had shown promise. The result, at that point, was a partially agreed joint draft text. Moreover, the Soviet Union had unilaterally suspended ASAT testing during the talks, from May 1978 until April 1980, and had made serious contributions.

THIS OPPORTUNITY for ASAT arms control was missed. But it was not the first, or the most crucial, opportunity. Unrecognized at the time, there had been two earlier occasions when the United States and the Soviet Union could have agreed on a ban on antisatellite weapons. The first was in negotiation of the understanding reached in 1963, and reflected in a U.N. General Assembly Resolution, banning the placement of nuclear and other weapons of mass destruction in space, and the subsequent incorporation of this ban into the Outer Space Treaty in 1967. But it was at that very time—in mid-1963—that the United

States moved to operational deployment of an ASAT (and an anti-orbital bomb) system. (I must admit to having participated in drafting the proposal for such deployment, which was approved by President John F. Kennedy in May 1963, carrying forward advanced development work by the Department of Defense already underway since early 1962.)

The omission of Earth-based ASAT systems, as well as space-based non-nuclear weapons, from the ban on placing nuclear and other weapons of mass destruction into space in 1963 and 1967 was not inadvertent. At that time, the focus was on barring offensive nuclear weaponry from space. Neither Washington nor Moscow had yet sufficiently thought through the questions of ASAT, or of antiballistic missile defense, to reach conclusions on their control. The Soviets also had not, at least in 1963, fully accepted the legitimacy of satellite reconnaissance. By 1967, there may have been such an opportunity, but the issue was never posed.

From 1963 until 1975 the United States had two operational ASAT systems deployed—one based on the Army's

The United States could have used its ASAT system to induce Soviet agreement to ban these weapons as part of SALT I.

Nike Zeus at Kwajalein Atoll (Program 505) from June 1963 to 1967, and one based on the Air Force's Thor missile at Johnston Island (Program 437) from June 1964 to April 1975. Although President Johnson disclosed the operational U.S. ASAT capability during the 1964 election campaign, the subject rapidly faded from public attention and memory. The *first* Soviet ASAT tests took place in 1967–1968—over five years after the first U.S. test—and testing, with a mixed record of successes and failures, continued until late 1971 when a hiatus of several years set in.

What was the Soviet thinking about ASAT at this time? We now know, from a heretofore unavailable authoritative source—the confidential Soviet General Staff organ, *Military Thought*—that the Soviets were keenly concerned about the American ASAT program and were led by it to pursue their own. As evidenced in this confidential journal, they had been well aware of the American ASAT programs between 1962 and 1964, but until Johnson's disclosure in September 1964 they had *not* recognized the operational status of the systems. Political critics who accused President Johnson at the time of disclosing military secrets for domestic political purposes were, in this instance, more right than they knew.

In the spring of 1966, Colonel A. Krasnov, a Soviet specialist, expressed his views in an article titled "Space and Combat Readiness." Rather than dealing with U.S. military space activities, he specifically declared that the ASAT requirement was "already not a problem for the distant future, but assumes current significance at the present time." The first Soviet full-fledged ASAT interception test took place on October 20, 1968.

One additional significant reference brings this account to its point of interaction with ASAT arms control possibilities. In April 1972, just as the ABM Treaty was in final negotiations, Major General M. Cherednichenko, a noted Soviet expert, wrote in *Military Thought* that both the Nike Zeus and Thor ASAT systems were operational and stressed U.S. plans to press ahead with improved non-nuclear ASAT systems, including those based on "exotic" future technology such as lasers.

While the Soviet military saw the American ASAT program as proceeding on full steam and alarmingly ahead of their own, American authorities were becoming increasingly doubtful of its value. For one thing, the large-yield nuclear warhead used with both systems would also cause considerable damage to U.S. communications. In fact, Program 505, the Nike Zeus ASAT at Kwajalein, had been formally deactivated in 1967, although this was not evident to external observation and was not known in Moscow. Moreover, in October 1970 Program 437, the thrust-augmented Thor ASAT system at Johnston Island,was placed on "standby" status, requiring 30 days to activate. Again, this was apparently not known in Moscow.

In August 1972 Hurricane Celeste so badly damaged the Thor installation (especially the Univac computers) that after three months of a premature and unsuccessful effort to reactivate the system in December 1972 it had to be withdrawn from active status until late March 1973. Finally on April 1, 1975, Program 437 was officially terminated and the nuclear warheads returned to the Atomic Energy Commission for disposal. (None of these developments appeared in the open press.) While this outcome was, of course, not predictable by either side in the early 1970s, what *was* known in Washington, but not in Moscow, was that the shortcomings of the U.S. system made it marginal and dispensable.

The operational U.S. ASAT system in 1969–1972 thus met the classic test of a "bargaining chip": something that appeared to the other side to be an unmatched asset and threat, while to us it was so marginal that it was maintained only on a standby basis. The United States had a "position of strength" from which to negotiate, and a "bargaining chip" Washington was prepared to cash in to reach reciprocal arms limits.

The United States could have used its ASAT system to induce Soviet agreement to ban these weapons as part of the SALT I Treaty. Since the Soviets saw the American operational and future capabilities as formidable while their own ASAT testing program was not doing well, they had substantial incentive to agree to a ban—but they believed they were in too weak a position to propose one. Responsible Soviet officials have recently told me that they would have jumped at a ban in 1972. And the Soviet ASAT satel-

lite-interception tests of 1968 through 1971 provided an incentive to the United States to agree to a ban before the Soviet Union developed a capability.

In addition, both sides were acquiring an increasing stake in various military uses of space and hence an interest in preventing the disruption of such activities by hostile action. Such a restraint would, moreover, have been a logical concomitant to the ABM Treaty provision prohibiting interference with national technical means of verification, including reconnaissance satellites.

Inclusion of a ban on antisatellite weapons in the Treaty would have considerably strengthened ABM restraints, since ASAT systems inherently have potential antiballistic missile capabilities. (The reverse, of course, is also true, because ABM systems also have ASAT potential.) But perhaps it could have meant even much more. As is known from Ambassador Gerard Smith's memoirs and other sources, the Soviet leaders showed interest in a possible complete ABM ban in November 1969, when SALT opened, and again in the summer of 1971—even after our earlier proposal, and Soviet acceptance in 1970 of a limitation allowing defense of the two national capitals. A proposal to dismantle the existing operational U.S. ASAT complex at Johnston Island (and the defunct one at Kwajalein) could have been tied to a proposal for Soviet dismantling of the operational ABM complex at Moscow; each side would dismantle its existing operational sites in a complete ban on ABM-ASAT deployment. As both extension and reinforcement of such a proposal, a ban on testing of all ABM and ASAT systems could have been included. In fact, while I was serving on the U.S. SALT delegation, a senior Soviet negotiator told me that in case a complete ABM ban were achieved, there would be no difficulty in agreeing on a broad ban on all ABM testing. It was the continued existence of even one or two allowed deployment complexes which justified some continued ABM development testing.

A complete ban on any ABM or ASAT systems would have been a powerful, mutually reinforcing and verifiable arms-control measure. Of course, an ABM-ASAT-*and* MIRV ban in 1969–1972 would have made a sea change in the whole strategic and arms control horizon. For example, apart from broader impact on the U.S.-Soviet strategic balance, a complete ABM ban might well have reduced British and French interest in follow-on MIRV systems to ensure the viability of their strategic deterrent forces, even without a U.S.-Soviet MIRV ban. The likelihood of British or French MIRVing would have been very low indeed. By precluding the MIRVed SS-20, the entire theater nuclear weapons situation would also have been very different.

UNLIKE THE POSSIBILITY of a MIRV ban in 1969 and even in 1970, or of a complete ban on ABM in 1969–1970 and again in 1971, the idea of an ASAT ban was not even raised or debated in the United States in the critical years 1969–1972, or indeed until 1976–1977. As one involved deeply in those deliberations, I am now particularly regretful that this opportunity was not appreciated at the time. No doubt proposal of an ASAT ban would have provoked resistance—even though those who would have objected did not care enough to keep an operational ASAT or renew an active development program until 1977. But the issue was not even recognized and posed.

Since 1977, the Soviet "lead" in having a deployed, operational ASAT system (even though severely limited in effectiveness) has worked against U.S. interest in ASAT control. It led to the Carter Administration's ill-fated "two-track" approach. Since at least 1979, while the "promise" in the American program has stimulated Soviet interest in an ASAT arms limitation agreement, it has diminished official American readiness to pursue such an agreement.

Thus we missed opportunities in 1963–1967 and 1969–1972 when the United States had a marginal lead; and in 1977–1980 when the Soviet Union had a marginal lead. Soon we will have another U.S. lead, with a system whose deployment would be very difficult to verify. Even more important, both sides will be working toward greater anticipated advances. Such technical advances are all too likely, but they will spell reduced security for all rather than real advantages for either.

Finally, ASAT programs, by design or unavoidable impact, will erode the existing ABM Treaty restraints on development of ballistic missile defenses. Now is the time to move forward with ASAT arms control before we lose what may be the last real opportunity. □

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The independent U.N. commission on environmental problems could help to establish a sound ecological base for sustainable development, but questioning long-term environmental trends could impede progress.

New global environment commission

by Erwan Fouéré

A RECENT DECISION by the U.N. General Assembly to establish an Independent World Commission on Environment and Development received little if any publicity.

Perhaps the thought of yet another independent commission, following on the heels of the Brandt and Palme Commissions, aroused more skepticism than interest.[1] Having witnessed the meager response from the world's leading nations to the recommendations of both Commissions, one can easily understand those who saw nothing particularly novel in this U.N. decision.

Yet this latest initiative, sponsored by the governments of Switzerland (the Commission's headquarters will be in Geneva), Japan, Canada, the Scandinavian countries and the Netherlands, will have at least one important distinguishing feature. The decision establishes a direct link between the Independent Commission and U.N. member governments, and stipulates that the Commission's report and recommendations, to be submitted within two years (its inaugural meeting will be in late September or early October), are to be considered by governments, by the U.N. Environment Program's Governing Council and by the General Assembly.

Few would disagree that the weakness of both the Brandt and Palme Commissions' reports and recommendations lay in the fact that there was no such institutional link with governments or with the United Nations. Of course, an obligation to consider the report by no means guarantees the necessary follow-up action. The final clause of the decision, which states that "the report of the Commission will not be binding on governments," is telling in this respect. But it at least ensures that governments will be obliged to prepare and put forward their views on the recommendations. The debate that will be generated both within the United Nations and among governments on a bilateral and regional level will provide a focus for worldwide attention to environmental problems. It should also help to promote an awareness of the underlying environmental dimension of many of the world's economic and social dilemmas and the threats they pose to international security.

The strength of the Commission's recommendations will thus not rely solely on the international prestige of its members and their powers of persuasion, as was the case with the Brandt and Palme Commissions. It will also depend on the pressure that the Commission will be able to put on governments to fulfill their commitments to address the recommendations.

This link could also contribute to the Commission's undoing. Indeed, it will be a tribute to the political adroitness of its members if they succeed in preventing individual governments or interest groups from exerting undue pressure or imposing limitations on the content of the recommendations.

JUDGING FROM ITS terms of reference, the Commission will not have an easy time. It is being asked to:

- propose long-term environmental strategies for achieving sustainable development to the year 2000 and beyond;
- recommend ways in which concern for the environment may be translated into greater cooperation among developing countries as well as countries at different stages of economic and social development;
- consider ways and means by which the international community can deal more effectively with environmental concerns;
- help define shared perceptions of long-term environmental issues and of the efforts needed to deal successfully with protection and improvement of the environment, and to put forward an agenda for action over the coming decades.

The establishment of the Commission comes at an opportune time. Growing pressures on environmental resources highlighted in numerous reports and studies have not subsided. We can continue to expect a world more crowded, more polluted, less stable ecologically and more vulnerable to conflict and social upheaval than it is now. What is more alarming is that many of these problems of global concern are concentrated in developing countries and are already so serious that many millions of people are denied necessities: food, shelter, health, jobs, or any hope of betterment. There is also the continuing cycle of desertification, loss of arable land through soil erosion, deforestation and several other phenomena, the effects of which have yet to be assessed.

In spite of these worsening problems and the underlying threat, as yet greatly underestimated, which they pose to international stability, the response has been far from adequate; governments are seemingly unable or unwilling to come to grips with the issues. The increasing tendency of

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governments to delay the implementation of long-term solutions to many of the problems has invariably led to short-term, improvised decision-making, best described as crisis management. The size and complexity of the issues are immense. And by sacrificing the long-term solution for a short-term gain, dictated more by political and electoral motives than by a desire to attack the root causes, the problems are only exacerbated in the long run.

A further complication is the growing tendency, notably in the United States, to question the validity of long-term trends in global environmental issues as predicted in several reports and studies. This has resulted in a slowdown of the process of achieving a political consensus which had been emerging internationally. The absence of such a consensus will make it increasingly difficult to achieve any progress in dealing with the problems.

BECAUSE IT HAD BEEN the undisputed leader in promoting international action on environmental and global resource issues, much attention will be focussed on the United States. It is now generally recognized that America has effectively relinquished its traditional role on these issues. This is all the more apparent since it was initiatives taken during the Nixon and Carter presidencies, in particular, which did much to galvanize the more reluctant governments into action. The United States was a catalyst in developing a consensus among scientists and decision-makers on some of the actions urgently required internationally. The "Global 2000 Report" and the subsequent document, "Global Future: A Time to Act," prepared at the instigation of former President Carter, were followed by similar exercises in several countries, notably Canada and Japan. Both documents also stimulated major reflection within the Organization for Economic Cooperation and Development (OECD), resulting in the publication of a report on the growing interdependence of economic development and ecological issues.[2]

The cumulative effect of these initiatives was a heightened degree of international cooperation: the launching of negotiations for a convention on the protection of the ozone layer; the conclusion of negotiations for a convention on long-range, trans-boundary air pollution, with an emphasis on acid precipitation; measures adopted within the OECD aimed at harmonizing international controls on the marketing of chemical substances; the gradual integration of environmental considerations into the development policies of multilateral and bilateral aid agencies, and many others.

The sudden change in the U.S. government's approach, following the installation of the Reagan Administration, had widespread repercussions. The effect of this change seems to have been greatly underestimated by the Administration; it has brought the United States into open confrontation with countries where close cooperation in environmental and related issues had always been taken for granted. And it has also served to underline the way environmental concerns increasingly impinge on foreign policy considerations.

One example, which greatly damaged the U.S. record on such cooperation, related to work within the OECD on chemicals. Major difficulties arose over the refusal of the American delegation, then headed by the former administrator of the EPA, Anne Burford, to accept a binding commitment to apply the OECD draft decision on the minimum pre-marketing set of data. This draft decision set out the minimum information which as a rule should be provided by the manufacturer to allow initial assessment of a new chemical before a decision is taken to market it. In an area where trade plays an essential role, uniform implementation by OECD members was vital. Failing a U.S. commitment to the decision, a compromise formula was ultimately adopted by OECD members and by the European Community. The terms of the compromise, however, greatly reduced the effectiveness of the decision.

Similar problems arose in the context of implementing the convention on long-range trans-boundary air pollution, as well as in negotiations for the U.N. Convention on the Law of the Sea, which had involved over 15 years of difficult and painstaking discussions. In the case of the former issue, the U.S. Administration contended, and continues to do so, that further scientific research was required before any action, preventive or remedial, could be taken or even considered. Interestingly enough, this is one area where America and most of the East European countries (including the Soviet Union) are in agreement. On the other hand, most West European countries have adopted corrective control measures on sulphur dioxide emissions, whether individually or within the European Community.

On both sides of the Atlantic, opinion polls continue to show great support for measures to improve the environment.

While it is certainly true that we are unlikely ever to have a perfect understanding of most environmental issues, it would be unwise to use this as an excuse for delaying any form of action. As was pointed out during a recent OECD conference on global environmental issues:

> In the absence of scientific consensus, political consensus, especially at the international level, is hard to achieve. However, if governments wait for scientific near-certainty, it will often be too late for them to act at all, either because of the inertia of natural phenomena or because of the time lags associated with policy development and international negotiation.

PROBABLY more serious, because of the wider repercussions, has been the systematic policy of reducing the U.S. contribution to a number of key organizations working on

environmental cooperation while other countries have been either raising their contributions or at least maintaining them at current levels. The most recent reduction in the U.S. contribution to the World Bank and its soft loan affiliate, the International Development Association (IDA), will seriously undermine rural development and technical assistance programs in many parts of Africa. The president of the World Bank, A.M. Clausen, announced at the end of 1983 that its subsidized aid program for the poorest nations will be held at $9 billion over the next three years, 25 percent less than the amount that all donor countries except the United States had argued was the minimum needed. Clausen, who was campaigning to have the resources available to IDA increased, also announced that he would seek to get other nations to put up additional funds. They did so last year, when the United States also fell short in its commitments for the current IDA program which ran out on June 30.

In a keynote speech to the June 1983 Conference on Global Resources, Environment and Population, convened by the Global Tomorrow Coalition, former President Carter pointed out that "the deliberate across-the-board abandonment of U.S. leadership on environment, resources and related global issues is of grave concern. . . . Without leadership from within our own country, concerted action among other nations is unlikely."

Indeed, America's commitment to international environmental action—effectively making it an important component of U.S. foreign policy—was such that few governments could hope to fill the gap. International cooperation in this area has suffered as a result. While the appointment of William Ruckelshaus has certainly helped to restore some degree of confidence in the American commitment, it will take a long time to recover the ground lost since early 1981.

Carter himself was considered by the main sponsor countries to be the best candidate for the post of Chairman of the Independent Commission. But opposition by the Reagan Administration put an end to this possibility—all the more regrettable in view of his international prestige and commitment to global environmental issues.

The person who was chosen to chair the Commission, Gro Harlem Brundtland, has impeccable credentials for the job. She has served as prime minister and environment minister of Norway, and is currently a leader of the opposition Labor Party. Recognized as having considerable political expertise and acumen, she will need these attributes in steering the Commission through the difficulties which it will encounter, above all making sure that the Commission is not independent in name only.

THE TASKS FACING the Commission are formidable, but at the same time provide it with a unique opportunity. By its very existence the Commission should be able to contribute toward achieving the international political consensus that is so vital. Its success will be judged by the innovativeness of the long-term strategies it puts forth for government consideration. These should reflect far more than the lowest common denominator; they should constitute a veritable environmental foreign policy, to be adopted by governments and regional and international organizations, as well as by the community at large. This in itself will ensure that the environment will no longer be viewed in isolation, but as an integral part of sound economic and social development.

More and more countries now understand that they must prevent problems from arising rather than aim at clearing them up afterward. The adoption of anticipatory environmental policies is certainly not easy. By their very nature they require action before damage to the environment has created a demand for it. Yet the difficulties encountered are in general far outweighed by the advantages. And as many studies, particularly from the OECD, have shown, preventive policies are far less costly than curative ones.

A major problem for the Commission will be to put together reliable data on the condition of the world's environment and natural resources, as well as a credible analysis of possible future trends, which will stand up to the severest of critics. Julian Simon and Herman Kahn, for example, used this particular problem to reject the findings of "Global 2000 Report."[3] The need for sound environmental data and a coordination of environmental indicators for purposes of comparative analyses and accurate projections of future trends is well recognized. The criticism leveled by Simon and Kahn, however, was more gratuitous than constructive in that they provided no data of their own to substantiate their contention that life on planet Earth was getting better, not worse.

Public opinion will be a severe judge of the Commission's findings and recommendations. On both sides of the Atlantic opinion polls continue to show that, despite the present economic climate, measures to improve the environment enjoy a very high degree of support. In the countries of the European Community, more than 60 percent of the people consider these to be more important than measures to control prices.[4] Increasingly, too, in developing countries there is a growing realization that sustainable growth and economic development can only occur on an ecologically sound base.

The Commission will thus need to demonstrate its ability to formulate new directions in the wider use of the knowledge and tools with which science has equipped us. This will involve a continuous search into cause and effect and an unending effort to match technology with higher levels of thinking. □

1. The Independent Commission on International Development Issues, headed by Willy Brandt, issued two reports: "North-South: A Program for Survival" (1981); "Common Crisis" (1983). The Independent Commission on Disarmament and Security, headed by Olaf Palme, issued one report: "Common Security" (1982).

2. "Economic and Ecological Interdependence," OECD publication (1982).

3. Heritage Foundation Reports, "Global 2000 Revised"; "The Global 2000 Juggernaut" (1983).

4. "Euro-Barometer," 18, published by the Commission of the European Communities (Oct. 1983).

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Jim Mendenhall

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A series of articles in the Wall Street Journal *alleged that the Soviet Union is engaged in a major biological weapons program. But the evidence is sparse and indirect.*

Yellow rain or yellow journalism?



by Leonard A. Cole

BETWEEN APRIL 23 AND May 18 the *Wall Street Journal* published a series of eight articles by William Kucewicz, an editorial writer for the newspaper, purporting to show that the Soviet Union is engaged in a vigorous biological warfare program.

Kucewicz's charges are terribly serious. He says that although the Soviet Union, like the United States, signed the 1972 Biological Weapons Convention, the Soviets have never adhered to the Convention's ban on the development and stockpiling of biological weapons. He claims that the Soviets are engaged in a program to produce frighteningly effective biological weapons through recombinant DNA techniques and thus titles the series, "Beyond 'Yellow Rain,' the Threat of Soviet Genetic Engineering."

Even if the Soviets are trying to develop a super-germ, many molecular biologists feel unthreatened because they believe that genetic engineering would be a wasteful if not an impossible approach to such a goal. This is the position not of "leftist scientists," as Kucewicz describes skeptics, but of the United States government as conveyed to me by the chief of public affairs at Fort Detrick, Maryland, America's biological warfare headquarters.

Leonard A. Cole, adjunct professor of political science at William Paterson College, New Jersey 07470, is the author of Politics and the Restraint of Science *(1983). His current project is a book on the history of U.S. biological warfare testing.*

We already know how to produce extremely lethal bacteria and toxins. Recognizing that the use of such weaponry would be questionably effective and morally repugnant, President Richard Nixon in 1969 announced that the United States was unilaterally destroying its biological arsenal. Within two years the Soviet Union agreed to renounce biological warfare, and in 1972 the two powers, followed by more than 80 other nations, signed the Convention. If Kucewicz is correct about Soviet violations, the casualties will include not only this international agreement; the possibilities for arms control agreements of any kind will probably have been foreclosed.

Is Kucewicz correct? If he is, it is surely not because of the content of his month-long exercise. His series was remarkable less for the evidence he produced than for the relentless drumbeat of his message. Kucewicz repeats his thesis in article after article, and evidently the newspaper's publishers felt that such repetition could make up for a scarcity of proof.

Kucewicz informs us early in the first installment that his evidence "rests foremost on interviews with a number of former Soviet scientists now living in the U.S." Yet in the entire series he names only one such scientist who addresses the issue, Michael Zakharov. Zakharov had no first-hand knowledge but had heard from others that Soviet scientists were trying to develop biological weapons through recombinant DNA techniques. Other emigré scientists apparently agree with Zakharov's story, but who they are is not revealed, since "they asked not to be identified" for fear of reprisal against friends and relatives. We never learn how many emigré scientists were interviewed, whether any were molecular biologists, or what relationship they had with the alleged biological warfare activities. If they did indeed provide the foundation for the *Journal*'s sensational thesis, we are entitled to know more about them.

The only other named emigré who discusses the charges is Mark Popovsky, a former science writer who left the Soviet Union in 1977. Popovsky tells of a meeting in 1974 at which Professor Yury A. Ovchinnikov, a vice president of the Soviet Academy of Sciences, announced that the Soviets would embark on a program to create bacteriological weapons through genetic engineering. While other (unnamed) emigrés agree that Ovchinnikov heads biological warfare research, at least one disputes the accuracy of Popovsky's version of the meeting.

Thus the only two emigré sources named in the *Journal*'s series can hardly be considered unimpeachable witnesses. As for the unnamed scientists, were there two or 20, and

was their information based on rumor or fact? We are never told.

KUCEWICZ DEVOTES the succeeding articles to particular issues which in the end, he says, make "an impressive case" that the Soviets are using genetic engineering to create battlefield bacteria. He cites the Soviet Union's past interest in biological weapons, the nature of certain scientific articles in recent years, the inability of an eminent microbiologist to emigrate, the alleged use of biological weapons in Afghanistan and Southeast Asia, and the anthrax epidemic in Sverdlovsk. That each of these issues is debatable he barely acknowledges.

The article dedicated to historical review is plainly irrelevant. Its centerpiece is a lengthy recapitulation of a report written in the late 1940s for U.S. intelligence, revealing that the Soviet Union was then involved in chemical and biological warfare preparations. This evidently is meant to show that the Soviets have always been fond of bacterial weaponry and to explain the roots of today's purported program. It makes as much sense as quoting from a U.S. War Department report on the American biological warfare program written in 1946: "Work in this field, born of the necessity of war, cannot be ignored in time of peace; it must be continued."[1] Should such 1940s wisdom give rise to suspicion that today the United States is ignoring treaties that it subsequently signed? That seems to be the intended message about the Soviet Union.

Additional evidence of nefarious Soviet activity, Kucewicz believes, is found in the large number of articles in Soviet scientific literature on snake venoms and other neurotoxins. He acknowledges, however, that "Pentagon projects look similar to those in the Soviet open literature." What kind of evidence is this? It could mean that the Soviet Union is acting illegally, that the United States is, or that neither is.

In another *non sequitur* we are told that the suspension of an exit visa to Soviet microbiologist David Goldfarb helps confirm the existence of a Soviet genetic engineering weapons program. After years of waiting, Goldfarb and his family received permission to emigrate to Israel early in 1984. Their visas were suspended when the KGB intervened, claiming that Goldfarb intended to take his collection of bacterial strains with him. While the KGB held that the material was of "national security importance," Goldfarb insisted that he had never engaged in classified work. This leads Kucewicz to conclude that the Soviets show "particular sensitivity about microbiology," and that it supports suspicions that "Soviet Russia intends to use molecular genetics for biological warfare."

In fact, Goldfarb was the first scientist of professorial rank in *any* discipline to receive an exit visa in six years. If microbiology has become so patently connected to military activity, why were other microbiologists allowed to emigrate a few years ago, and why was Goldfarb given an exit visa in the first place? Nan Greifer has written recently that many believe the Goldfarb case "had little to do with classified material, but reflected instead disagreement between the KGB and senior scientific circles who had gone over the KGB's head to get Goldfarb an exit visa."[2] About this we hear nothing from the *Wall Street Journal*.

KUCEWICZ ALSO discusses the "yellow rain" mycotoxins allegedly used by the Soviets or their surrogates in Afghanistan and Southeast Asia and the anthrax epidemic in Sverdlovsk in 1979. In neither case does he offer more than a nod to the fact that culpability and causes are in dispute. Rather, he calls yellow rain "the best-known demonstration of the active Soviet biochemical military program," and says without qualification that the anthrax epidemic was caused by "an accident at a biological-weapons facility."

Scientists still disagree about whether yellow rain was of natural or manmade origin. As Philip Boffey reported while the *Journal* series was running, the National Academy of Sciences has sifted the evidence and has been unable to come to a conclusion. Moreover, as the samples of mycotoxins continue to age, analysis becomes more difficult, and we may never know their origins.[3]

In the matter of the anthrax outbreak in Sverdlovsk, the Soviet Union blamed tainted meat sold on the black market. Kucewicz opts for the U.S. government's conclusion that anthrax bacteria were released during an explosion at a biological-weapons plant. Again, however, he is selective with his evidence, ignoring the facts that anthrax is endemic in the Sverdlovsk area and that an epidemic is always a potential danger there.

The most unfortunate result of the Journal *articles would be to encourage more U.S. biological weapons activity.*

Elsewhere in his series he cites microbiologist Raymond A. Zilinskas favorably when he agrees with Zilinskas's view that biological warfare has become technically more feasible. Yet in the Sverdlovsk discussion Zilinskas's name is nowhere to be found. The *Journal*'s readers might have been interested to know that in the June/July 1983 *Bulletin* Zilinskas assessed "all available information" and determined that the epidemic was most likely caused by "an infected animal . . . rendered into sausages and sold on the local black market."

Kucewicz says that a secret U.S. intelligence report on the Sverdlovsk episode helped convince him of the validity of the government's version. He cites the report, which presumably remains secret (how did he get it?), as saying that after the epidemic began Soviet epidemiologists arrived in Sverdlovsk, followed two weeks later by the defense and health ministers. "Their visits were not publicized," Kuce-

wicz says. Evidently this is supposed to suggest sinister activity. But one might wonder why the defense minister took two weeks to arrive if there had been a military accident bearing such enormous implications.

All this is not to deny the possibility that the Soviets are trying to develop bacterial weapons by genetic engineering or that, as Kucewicz declares, "the Soviet Union has never halted its biological weapons program." But the move from possibility to probability requires far better evidence than appears anywhere in the *Journal*'s series.

For Kucewicz the clinching argument that genetic engineering is "a natural and almost inevitable next step in the Soviet biochemical weapons program" is a passage in the 1983 edition of the Soviet *Military Encyclopedia*. He is so impressed by the passage that he refers to it in three of his articles and offers identical quotations in two: "Achievements in biology and related sciences . . . have led to an increase in the effectiveness of biological agents as a means of conducting warfare." Is this really an indication that the Soviets are engaged in biological weapons development? Raymond Zilinskas said almost the same thing in an American publication and, as mentioned, Kucewicz simply agreed with him.

The most unfortunate consequence of the *Journal* articles would be to encourage more U.S. biological weapons activity, tempting us to violate the 1972 Convention. The chemical-biological warfare budget will have grown from $160 million in 1980 to a projected $1.1 billion in 1985 if the Reagan Administration has its way. What Kucewicz is convinced of, the Administration almost believes anyway, as Secretary of Defense Caspar Weinberger's report on Soviet military power indicates:

> Soviet research efforts in the area of genetic engineering *may* also have a connection with their biological warfare program. There is an *apparent* effort on the part of the Soviets to transfer selected aspects of genetic engineering research to their biological warfare centers. For biological warfare purposes, genetic engineering *could* open a large number of possibilities. Normally harmless, non-disease producing organisms *could* be modified to become highly toxic or produce diseases for which an opponent has no known treatment or cure. Other agents, now considered too unstable for storage or biological warfare applications, *could* be changed sufficiently to be an effective agent (emphasis added).[4]

Kucewicz quotes Weinberger's comments but says nothing about the qualifiers that render the paragraph virtually meaningless. Apparently he is so convinced that he is right that by the end of the series he feels free to ignore them. The final installment concludes with an admonition that everyone should "come to grips with the Soviet genetics warfare program."

THE PENTAGON has evidently made the same assumption. It is engaged in or funding 43 recombinant DNA projects involving the production of vaccines and other "defensive" work. Even if these efforts remain defensive, American citizens have reason to worry. My particular concern arises from attempts to test domestic vulnerability to biological warfare attack.

In the late 1970s the public learned that the Army had secretly exposed millions of Americans to supposedly harmless bacteria and chemical particles. The Army was observing the patterns of dissemination of the germs in preparation for an enemy attack with more lethal bacteria. Throughout the 1950s and 1960s bacteria and particles were dropped over hundreds of populated areas including San Francisco, Panama City, Minneapolis, parts of Alaska and Hawaii, and into the New York City subway system and onto the Pennsylvania Turnpike. During Senate hearings in 1977 Army spokesmen indicated that open air "vulnerability testing" was not then taking place but that it might be resumed whenever the Army felt a need.[5]

As previously classified reports revealed at the hearings, the bacteria that the Army thought were harmless could have been causing disease. Another drawback in these procedures has been that the simulant germs were only roughly akin to the ones that cause anthrax, plague and the like. In trying to overcome this drawback, someone might decide that a perfect simulant for pathogenic bacteria would be the pathogenic bacteria themselves, with a slightly altered genetic structure to eliminate their pathogenecity.

Whatever its appeal at germ-warfare headquarters, from an ethical and safety point of view the idea is terrible. Despite the Army's position that its vulnerability testing is harmless, *any* bacteria concentrated in large numbers may threaten the well-being of exposed people. This is particularly true for people who are compromised hosts—the very old, the very young, the debilitated or the ill.

This is only one of many unpleasant possibilities that might emerge from an accelerated biological warfare program, even one limited to "defensive" efforts. The *Journal* series could help to stimulate such activities in other countries as well. The articles are thus worrisome and regrettable. Occupying more than 350 column inches, divided into eight installments, they make presumptions about Soviet activities that are based on exceedingly sparse evidence. In their wider effects, they can only worsen the already parlous state of Soviet-American relations. □

1. "Report to the Secretary of War by Mr. George W. Merck, Special Consultant for Biological Warfare" (Jan. 3, 1946), in *Biological Testing Involving Human Subjects by the Department of Defense, 1977*; Hearings before the U.S. Senate Subcommittee on Health and Scientific Research of the Committee on Human Resources, March 8 and May 23, 1977 (Washington, D.C.: U.S. Government Printing Office, 1977), p. 71.

2. Nan Greifer, *Jews in the Soviet Union* (London: National Council for Soviet Jewry of the United Kingdom and Ireland, 1984).

3. Philip M. Boffey, "Evidence Is Fading as U.S. Investigates Use of 'Yellow Rain,'" *New York Times* (May 15, 1984), pp. A-1, B-6. See also Joan W. Nowicke and Matthew Meselson, "Yellow Rain—A Palynological Analysis," *Nature*, 309 (May 17–23, 1984), pp. 205–6; and John Maddox, "Natural History of Yellow Rain," *Ibid.*, p. 207.

4. U.S. Department of Defense, *Soviet Military Power, 1984* (Washington, D.C.: U.S. Government Printing Office, 1984), p. 73.

5. *Biological Testing*, p. 18.

Books

Edwin Diamond reviews

Open Skies
by Walter W. Rostow
Ideas and Action Series, University of Texas Press
228 pages, $25.00; $10.95 paper

Imagine that you are a fly on the wall in the Oval Office. Ronald Reagan and his aides are making a major nuclear policy decision, say, about the zero-zero option or new instructions to be given Paul Nitze as he prepares to return to negotiations with the Soviets in Geneva. Imagine, in fact, that you are superfly: not only can you hear and record all the conversations, read all the action memos and option papers, but each of the participants immediately confides in you, giving you his thoughts and motivations, materials rarely shared with the public until the movers and shakers write their memoirs.

Every ambitious journalist fantasizes such entrée, and every serious citizen would profit from it. In the real world, however, press and public are fed bland releases and dissembling speeches. Only when the insiders' documents are declassified and the memoirs written do we get a fuller and—if we're lucky—more honest account.

Open Skies is such an account, as are the other books in Rostow's Ideas and Action Series (*Pre-Invasion Bombing Strategy; The Division of Europe after World II: 1946; Europe after Stalin; Eisenhower, Kennedy and Foreign Aid; The Barbaric Counter-Revolution*). Each volume analyzes American policy decisions over the past 30 years in which Rostow was a supporting actor and includes appendices of now-declassified records, participants' memoirs and other published scholarship. The most illuminating of Rostow's case studies, and the one of most interest to *Bulletin* readers, is *Open Skies*.

The year is 1955. Eisenhower is in the first term of his beneficent regime, Khrushchev is presiding over the post-Stalin Soviet Union, and development of thermonuclear warheads on intercontinental missiles has begun. A meeting of the leaders of the United States, Great Britain, France and the Soviet Union approaches in Geneva. Secretary of State John Foster Dulles, according to Eisenhower's memoirs, wanted the heads of government "only to define the crucial world problems and then issue a directive to the foreign ministers to work out details and conduct negotiations"—in short, to leave everything to Dulles.

Others had their own agendas. Eisenhower, who was already fighting his image as the golfer president, really believed in arms control, according to Rostow; in Eisenhower's words, he wanted to "open a tiny gate in the disarmament (*sic*) fence." In addition, the Joint Chiefs of Staff wanted to know how fast the Soviets were moving toward nuclear parity or superiority. And an exuberant Nelson Rockefeller, special assistant in the White House for public relations, wanted a Big Idea to make the president, the United States—and Nelson Rockefeller—look good. Thus from a five-day meeting called by Rockefeller at the Marine base in Quantico, Virginia, the Open Skies proposal was born on July 21, 1955.

Managing Environmental Risks Conference

Clarkson University, located in Potsdam, New York, will host a major three-day conference and workshop entitled "Managing Environmental Risks: Alternatives to the Land Disposal of Toxic Substances," October 2-4, 1984. The conference is intended for all segments of the public, while the workshop, which will be held October 4 at the Syracuse Airport Inn, Syracuse, New York, is intended for industry executives, state and local government officials and environmental consultants. For more information contact Doris Frazer, Conference and Information Center, Clarkson University, Potsdam, NY 13676, (315) 268-6647.

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by Lorin Peterson

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The United States and the Soviet Union were to exchange blueprints of their military forces and to allow each side to take unlimited aerial photographs of the other.

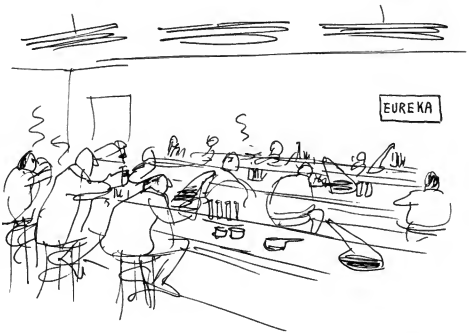
Dulles for the longest time fought the idea; it had, after all, come from Rockefeller, whose marauding style in the White House crowded Dulles's State Department. The Joint Chiefs, however, warmed quickly to what their chairman, Admiral Radford, saw as a no-lose proposition: If the Russians accepted Open Skies, he reasoned, "it will give the U.S. a decided intelligence advantage." (The Soviets, for their part, already knew just about everything of the American military establishment, thanks to published congressional hearings, the *New York Times* and Esso road maps.) If the Soviets turned down Open Skies, said Radford, "the U.S. would gain a decided public opinion advantage." Rostow, who chaired the Quantico meeting, believed that Open Skies "if rejected, would make unilateral photographic reconnaissance more justifiable." The U.S. could more comfortably launch U-2 overflights and surveillance satellites then on the drawing boards.

The Soviets rejected Open Skies, as expected, but apparently after serious considerations. And the United States achieved a quick public relations victory at Geneva, just as the Quantico seminarians predicted.

Open Skies died. Eisenhower was reelected, and Rockefeller moved back to New York to run for governor. The first ICBMs came on line in both countries, and the steady flights of reconnaissance satellites launched by both sides ever since have had more than enough subjects to photograph.

Rostow shows the negotiating lesson to be drawn from Open Skies. The United States had pushed to open Soviet skies to close the "intelligence gap" favoring the Soviet Union. The Soviet Union had pushed to destroy American atomic weapons to close the "missile gap" favoring the United States. Thus, neither side would give the other what it wanted. While Rostow is still a few cases away from a general conclusion, he offers enough material for us to realize that nothing much has changed from the 1940s and 1950s to what is going on in the Oval Office, Executive Office Building, State Department and Pentagon right now. □

Edwin Diamond, adjunct professor in the department of political science at the Massachusetts Institute of Technology in Cambridge (02139), is currently doing a study of nuclear decision making.



Al Ross, United States

Joel Genuth reviews

The Discoverers: A History of Man's Search to Know His World and Himself
by Daniel J. Boorstin
Random House
745 pages, $25.00

This massive book is more a celebration than an analysis of history. As a celebration, the book is generally effective because Boorstin has a pleasing style and a firm grasp on what makes history intriguing: practices which we recognize as routinely filling a particular niche in our own world look startlingly puzzling when seen as part of a different order; concepts which we take for granted today acquire renewed interest when viewed from the period in which they had to be justified. The book covers an enormous range of subjects and spans centuries of history—thus its exceptional length—but length and quantity of material should deter no reader, for the book is broken into numerous sub-divisions, and episodic, selective reading is entirely possible. A bibliographic essay at the end of the book nicely guides the reader to more scholarly works on each topic. Boorstin has likely done the history of science a fine service. I can think of no other work which provides the general reader with a sense of why some historians can get their intellectual kicks from reading old scientific papers and treatises.

Any criticism of Boorstin, on the heels of the previous sentence, may seem ungracious. Nevertheless, I was disturbed to find that my level of fascination with *The Discoverers* was inversely related to the amount I previously knew about the subject under discussion. I suspect that in a discussion of this book among specialists, each would claim that while Boorstin did a fine job

with the others' fields, he had distorted the specialist's own. Such criticism is not gratuitous if there is some consistent bias to the distortions.

It is easy for me to list complaints about Boorstin's treatment of the Scientific Revolution, the subject about which I know most: he does not adequately stress that Copernicus's heliocentric system undercut the extant terrestrial mechanics without offering any alternative; he ignores the problems with Galileo's theory of the tides and the role these problems played in bolstering the Church's position in their dispute; his account of Vesalius's and Harvey's attack on Galen's anatomy fails to point out that the new anatomical discoveries had no immediate therapeutic consequences, leaving Galen's theory of humors intact in the area of medical treatment; his discussion of Newton's relationship with Leibniz focuses on their dispute over the calculus rather than their more interesting philosophical dispute over the theory of gravitation; his account of the founding of the Royal Society does not address the Society's relationship to other institutions in seventeenth century England and the political upheavals of that time.

These problems may be simply due to the unavoidable compression of large amounts of material. Then again, they may also be based on an inadequate respect on the part of Boorstin for the integrity of past theoretical and social systems. In focusing on discoverers and their discoveries, Boorstin might have lost sight of the broader relations among theories and institutions in a given time and place. Against the broader backdrop, adherence to Ptolemaic astronomy or Galenic anatomy may reflect neither foolishness nor villainy but different values and loyalties. The history of discovery then becomes more complex and morally ambiguous than Boorstin's treatment of the Scientific Revolution suggests.

In analytic, rather than celebratory, terms, Boorstin's work lacks substance. He is remarkably uncritical about his most basic concept—"discovery." Included in the book are discussions of the

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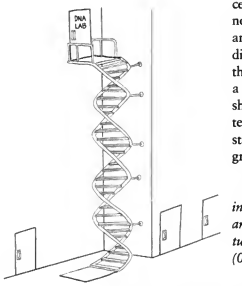
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Steven Wu, United States

ceptual change. Boorstin has certainly not provided a narrative structure which analyzes or explains the phenomena he discusses. I urge anyone curious about the history of science to give Boorstin a try. I also urge Boorstin's readers, should they hit a topic of particular interest to them, to tackle the more substantive works mentioned in the bibliography. □

Joel Genuth is a doctoral candidate in the Program in Science, Technology and Society at the Massachusetts Institute of Technology in Cambridge (02139).

Francesco Calogero reviews

Nuclear Weapons Databook. Volume 1: U.S. Nuclear Forces and Capabilities
by Thomas B. Cochran, William M. Arkin and Milton M. Hoenig.
Ballinger Publishing Company
359 pages, $19.95.

Arsenal: Understanding Weapons in the Nuclear Age
by Kosta Tsipis
Simon & Schuster
342 pages, $16.95

Readers looking for clear explanations of nuclear weapons would do well to acquire both of these books. The *Databook*, part of a planned eight-volume series, is primarily a reference work, although quite readable; *Arsenal* is meant for reading, although worth consulting for the facts it conveys. Together they provide both the arms control expert and the lay reader with an impressive, if disturbing, view of U.S. nuclear forces.

If subsequent volumes of the *Databook* match, or even approximate, the thoroughness and clarity of this initial book, the arms control community will have a very useful tool—and a relatively inexpensive one, given the large format, careful layout and profuse photographs of this volume. The book provides detailed coverage of the U.S. military complex. All the data are taken from open, and referenced, sources; the extensive information provided demonstrates the extreme degree of openness in American society.

The reader is struck by the degree to which nuclear weapons have pervaded the U.S. military establishment and by the unbroken expansion of nuclear systems. The book's tone remains cool and impassive. Such "objectivity" is less becoming in the large table listing nuclear weapons "retired from active service." There one finds the retirement dates of "Little Boy" and "Fat Man" footnoted as "Hiroshima, Japan, 6 August 1945, at 8:15 a.m." and "Nagasaki, Japan, 9 August 1945, at 11:02 a.m." respectively. Precise this description may be, but what impression will such impartiality make on someone who was near Hiroshima or Nagasaki, or whose relatives were there?

Nevertheless, the empirical attitude adopted by the authors makes the *Databook* a good reference work, especially for teachers and students in courses on arms control and international security. One moreover hopes that the project that has produced this book, in addition to delivering the other volumes planned, will also set up some procedure to update periodically the data in each volume. (If the acceleration of the nuclear arms race continues, this will soon be needed.)

Kosta Tsipis needs no introduction to *Bulletin* readers, who know he is at his best when, relying on his background in physics, he sets out to unravel technical matters for a lay readership. The body of this book is indeed addressed to the lay reader, and it provides a thorough overview of nuclear weapons systems and their problems.

Arsenal follows the best tradition of scientific popularization, balancing simplicity, clarity and precision. The author falters only in the first chapter, which attempts to cover in 15 pages the history of the atom from the first discovery of radioactivity through Hiroshi-

ma and beyond. This oversimplified section could have been omitted.

A sizable portion of the book is devoted to a fairly technical presentation, organized in 13 appendices. The heterogenous menu includes "Ingredients of a Fission-Fusion-Fission Weapon," "Destructive Effects of a Nuclear Explosion upon Structures" and "Principles of Radar Operation." Here Tsipis addresses the reader who musters some elementary technical know-how. Yet the matter-of-fact presentation contributes substantially toward deflating the myth that nuclear military matters are too technically arcane to be understood by ordinary people (and average voters).

This reviewer takes issue with Tsipis on two points. While the author has been one of the most articulate critics of the cruise missile program, in *Arsenal* he downplays its danger. Also disappointing is his weak criticism of the "countersilo attack hypothesis." Such criticism is current in the U.S. strategic debate, which is all the more reason to emphasize it in a book of this nature.

Although both *Arsenal* and the *Databook* have their shortcomings, whoever believes that the public must be better informed on these matters will welcome both books. Anyone who hopes that a more sensible policy will prevail in the face of knowledge should contribute to their widespread circulation. □

Francesco Calogero, professor of theoretical physics at Universita degli Studi di Roma "La Sapienza," Italy, is a member of the Pugwash executive committee and the SIPRI governing board.

Coit D. Blacker reviews

Beyond the Hotline:
Controlling a Nuclear Crisis
by William Langer Ury and Richard Smoke
Nuclear Negotiation Project, Harvard Law School
87 pages, $10.00 (paper)

Avoiding Inadvertent War:
Crisis Management
edited by Hilliard Roderick and Ulla Magnusson
University of Texas Press
184 pages, $9.95 (paper)

Between Peace and War:
The Nature of International Crisis
by Richard Ned Lebow
The Johns Hopkins University Press
350 pages, $9.95 (paper)

For roughly 20 years, from the late 1950s to the late 1970s, the central concern of what we have come to describe, rather imprecisely, as the American arms control "community" was the limitation and reduction of U.S. and Soviet nuclear weapons through the process of bilateral negotiation.

While that concern continues to be important, especially to the many public interest groups that have made nuclear disarmament the principal focus of their political and educational activities, a subtle and interesting shift in emphasis has occurred in "elite" arms control thinking. This shift coincided, for the most part, with the collapse of the SALT process and the election of Ronald Reagan in 1980.

As the pursuit of bilateral, incremental and negotiated arms control agreements proved both more difficult and much more controversial than its advocates anticipated, intellectual interest in the subject declined markedly. The general conviction, widely held if not always expressed, that the current Administration is fundamentally hostile to arms control (despite participation in various negotiating forums) has reinforced the tendency among some arms control specialists to concentrate their energies elsewhere.

Increasingly, it seems, the intellectual vigor that once characterized the study and consideration of complex arms control problems has been redirected toward the study of U.S.-Soviet crisis management and the prevention of accidental and inadvertent nuclear war. The change is both positive and long overdue. For too long, American scho-



"How long can you wear that without feeling like you're inside of a clam shell filled with marshmallows?"

This complaint about the discomfort of protective clothing comes from one voice from the workplace quoted by Dorothy Nelkin and Michael S. Brown in WORKERS AT RISK.

In this arresting study of the physical and psychological hazards of working with chemicals, the authors do not use dry statistics or dispassionate surveys. They present the realities of the perceptions, feelings, and desires of workers.

Many express their worries about not being properly informed of dangers, about management caring only for profits, about company doctors caring only for companies.

The interviewees talk about how they cope. "The jitters go away," says one. Says another: "You never balance the wage against the risk; you balance the wage against the alternative. And the alternative is starving."

Nelkin and Brown believe that, in a society increasingly dependent on chemicals, "The voices of the workers, their identification of problems, their insights, and their views must be heard. They are critical to the creation of a more humane working environment."

Workers at Risk
Voices from the Workplace
DOROTHY NELKIN and MICHAEL S. BROWN
$20.00
University of CHICAGO Press

larship on the negotiated control of nuclear weapons has tended to focus on narrow, disaggregated technical issues which, while important intrinsically, very often have little to do with what remains, at base, a political problem between sovereign states.

In that sense, the renewed interest in both the prevention and the management of superpower crises is healthy. It is making us sensitive to the reality that no arms control agreement, whatever its technical merits, is likely to make us much safer until that effort is supplemented by greater understanding of why crises occur, and how to resolve them, once under way, without recourse to force.

The preferred strategy, one can infer, is the development of an agenda for improving U.S.-Soviet relations that makes possible simultaneous progress on both fronts—the political and the technical. The tendency within the scholarly community, however, is to treat these two dimensions separately. As suggested, today's intellectual fashion is to concentrate on the issue of nuclear war occasioned by crisis, accident or miscalculation, and to leave to some future (or past) group of analysts the consideration of negotiable arms control proposals. The approach is regrettable, although perhaps understandable, given the prevailing domestic and international political environment.

Of the several recent publications on crisis management and the prevention of accidental nuclear war, one of the best informed is *Beyond the Hotline: Controlling a Nuclear Crisis*. The study—actually a report prepared under contract to the Arms Control and Disarmament Agency—advances a number of very specific proposals for the creation of what the authors term a "nuclear crisis control system." While not everyone will agree on either the utility or the desirability of each of the eight steps proposed, Ury and Smoke are to be commended for the care with which they have advanced their ideas. The report is especially interesting in its attempt to distill from the literature on crisis management those findings or "lessons" of obvious relevance to the conduct of contemporary U.S.-Soviet relations.

For example, the authors urge the adoption of a "crisis consultation period," during which the United States and the Soviet Union would seek to signal their interest in averting war and in resolving the crisis while, at the same time, refraining from provocative military actions. The proposal is based on the observation, derived from analyses of previous crises, that leaders frequently feel compelled to act precipitately because of uncertainty over adversary intentions and the pressures of time.

To their credit, Ury and Smoke emphasize that a crisis control system would have important practical limitations, as some crisis situations are intentionally engineered by great powers in the pursuit of unilateral advantage. In those cases, they note, no "system" is likely to have much impact on the actions of either Washington or Moscow.

If the study has any significant shortcoming, it is the assumption that both superpowers have essentially the same understanding of the nature of crisis behavior and an equally strong incentive to manage such incidents short of war. In fact, Soviet writings on "crisis management" reveal a deep distrust of the process. The Soviet critique has two aspects: Soviet scholars argue that recent U.S. interest in crisis behavior is in reality a substitute for more traditional kinds of arms control negotiations, in which the current Administration is seen to have little interest. They also assert that without a renewed attempt to improve political relations and substantial prior progress in arms limitation any discussion of a cooperative regime to avert or manage crises is premature. Given the source, the critique is worthy of consideration.

Avoiding Inadvertent War: Crisis Management is the record of a conference sponsored by the Lyndon B. Johnson School of Public Affairs at the University of Texas in February 1983. Several of the contributions, while brief and informal, are excellent, including those by Barry Blechman on "U.S.-Soviet Nuclear Risk Management Centers," Alexander George on "Crisis Management: Requirements and Problems" and William Ury on "Strategies for Nuclear Crisis Control."

In general, however, the book has few of the strengths and many of the weaknesses of the Ury and Smoke volume. Its primary flaw is the lack of a clear definition of the problem being addressed. At one point in the proceedings Thomas Schelling remarks that any decision to launch U.S. or Soviet nuclear weapons would be the product of careful deliberation, even if the precipitating event could be characterized as inadvertent. The conferees do not, at any point, seek to sort out the possible significance of Schelling's comment. Nor do they ever explain precisely *why* the risk of an inadvertent nuclear war is increasing; that U.S.-Soviet relations are becoming more dangerous is simply assumed.

Of the three books under review, the most important is *Between Peace and War: The Nature of International Crisis*. Lebow has produced an extraordinarily sophisticated analysis, which focuses more on the origin, character and effects of crises than on their "management" or resolution. This is a serious, provocative and stimulating piece of scholarship that brings to bear important insights gleaned from the disciplines of history, political science and psychology. One need not agree with all of Lebow's interpretations of cognitive theory nor with his reading of historical events to appreciate the importance of his contribution.

Lebow is particularly interested in the process by which decision makers respond to crises. His primary reference point is the individual and, more narrowly, the interaction between the individual and his environment during times of acute stress. His discussion of such factors as "cognitive closure," the process by which people screen out or selectively reinterpret new information to accord with pre-existing beliefs, is fascinating and contentious, and thus likely to be debated at length. Lebow's

most provocative point is that the current emphasis on crisis management is probably misplaced, given the concentration on roles and procedures. In his view, the most critical variant of crisis behavior is individual psychology. His criticism is refreshing, if overstated.

Each of the three books is directed toward a different audience, and thus they are difficult to assess collectively. Scholars will find Lebow's work by far the most valuable; those primarily interested in policy issues will be drawn to *Beyond the Hotline*. The precise audience for *Avoiding Inadvertent War* is harder to define. □

Coit D. Blacker, associate director of the Center for International Security and Arms Control and acting associate professor of political science at Stanford University, is the co-author of Next Steps in the Creation of an Accidental Nuclear War Prevention Center *(1983).*

David Simmons reviews

Workers at Risk:
Voices from the Workplace
Dorothy Nelkin and Michael S. Brown
University of Chicago Press
248 pages; $20.00

In this excellent book, sociologists Nelkin and Brown let 75 workers tell what it's like to work awash in hazardous chemicals. Chemical process operators to pesticide sprayers to lab researchers discuss their fears, their perceptions of risk and their chances of changing workplace conditions. After learning why the book's subjects are kept in clouds of solvents, epoxies and pesticides, the reader is surprised that even some of the workers are still able to fight and demand better conditions.

Workers at Risk makes clear that most of those who face such risks have no say in the adoption of a risky process or substance. Yet they stay at their jobs without pressing for an end to dust and fumes—for economic reasons. They fear being fired or driving the company out of business. Many say "Just a few more years and then I'll retire," or "I'm too old to get another job now." These fears are underscored by other reasons: the machismo that dictates toughness; pressure to conform and not "make waves"; company doctors who tell workers no one else has their complaints; and corporate-paid experts who certify all company processes and products safe and "within acceptable limits."

For most workers, the job just goes on. The most striking thing about *Workers at Risk* is the similarity and repetition of the many reasons and pressures for doing nothing, and the uniqueness—and often the isolation—of those who do fight to change conditions. In one case it was the conviction that a worker's exposure to chemicals had caused his daughter's death from cancer, in another a family tradition of union militance, in a third a personal rebellion against the corporate structure felt to deny self-respect to a "mere worker." More detailed stories of those who rejected the health risk and accepted the risk of action would have made the book even more valuable. □

David Simmons edits the Chicago Committee on Occupational Safety and Health newsletter.

Conflict Resolution

The 1984 National Conference on Peacemaking and Conflict Resolution will be held ot the University of Missouri-St. Louis, September 20–23. Twenty workshops designed to develop skills and discuss specialized topics are scheduled for September 18–20. The conference continues the 1983 event held at the University of Georgia in Athens.

For more information, contact Margaret S. Herrman, NCPCR Secretoriot ond Program Co-Chair, 321 Academic Building, Carl Vinson Institute of Government, University of Georgia, Athens, Georgia 30602; telephone (404) 542–2887.

JUST PUBLISHED

Preventing War in the Nuclear Age
Dietrich Fischer, New York University

"Perhaps the most important book ever written about nuclear war... Distinctive, realistic and highly original, this book should be read by any person who is serious about what it means to be a citizen in the nuclear age."— *Richard Falk*

"A fresh, generous and thoughtful plea for thinking harder about the kinds of weapons and policies that do and do not help to keep our fragile peace... Fischer combines a passionate rejection of nuclear war with a talent for analytic clarity."— *McGeorge Bundy*
1984 / 248 pp. / $16.95 / ca $9.95 paper

JUST PUBLISHED

Moral Principles and Nuclear Weapons
Douglas P. Lackey, City University of New York

Is nuclear war ever morally justified? Is it morally justified to possess nuclear weapons, intending to use them only for defense? Is it morally justified to threaten to use nuclear weapons in order to prevent nuclear attacks? Is it morally justified to launch a nuclear counterattack in response to a nuclear first strike? Professor Lackey answers these and related questions in the light of contemporary moral theory and in the light of traditions about the justice of war.
1984 / 320 pp. / ca $25.00

Risks of Unintentional Nuclear War
Daniel Frei with Christian Catrina, University of Zurich

"Here at last is a study that both the disarmer and planner can read with great profit."— *Choice*
1983 / 288 pp. / $12.50 paper

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International physicians meet

by Ted Strom

OVER 300 DOCTORS and medical students, representing more than 40 countries, met from June 4 to 7 this year in Helsinki, Finland. The occasion was the Fourth Congress of the International Physicians for the Prevention of Nuclear War.

Despite an excess of self-congratulatory speeches, the Congress had its brilliant moments. Among the speakers at the opening session were the organization's co-presidents, Dr. Evgeny Chazov, director general of the Soviet Union's National Cardiological Research Center, and Dr. Bernard Lown, professor of cardiology at the Harvard School of Public Health. In addition, Prime Ministers Kalevi Sorsa of Finland and Andreas Papandreou of Greece addressed the Congress, recommending measures to be taken for controlling the nuclear arms race in Europe. Both called for the establishment of a nuclear-free zone stretching from the Balkans to Scandinavia. Papandreou also called for a six-month freeze on missile deployment in Europe.



SECOND EDITION

Stanford Arms Control Group. Edited by Coit D. Blacker and Gloria Duffy. This book presents a completely revised and updated analysis of national and international arms control: its history, philosophy, achievements, and future prospects, as well as its political, military, and economic ramifications. Cloth, $45.00; paper, $16.95

Stanford University Press

In his keynote address, Dr. Howard Hiatt, dean of the Harvard School of Public Health, depicted the grotesque imbalance between what could be done to limit infection and hunger in the Third World and what has actually been done with our resources. Drawing an analogy with Sir John Snow's theft of the Broad Street water-pump handle to end a cholera epidemic in London, Hiatt argued that physicians have an obligation to do more than present medical facts on nuclear war to the public. They must, he asserted, "help political leaders find ways to control nuclear weapons."

In the remaining days of the Congress, delegates participated in working groups and research symposiums which moved beyond simple reiteration of standard ideas. Topics covered ranged from theoretical investigation of psychological defenses that restrain work for peace to pragmatic consideration of the issue of nuclear education in medical schools.

In a research symposium on "The Impact of the Threat of Nuclear War on Children and Adolescents," for example, studies from a number of countries were presented which suggested that children and teenagers are frightened by the potential for nuclear war. Although improved survey methods strengthen the possibility that these studies are correct in identifying concern in these age groups, little is known now about the capacity to handle such anxiety and its impact on development.

Nuclear winter was also a major issue, particularly among delegates from those countries not heavily targeted by the superpowers. Dr. Jack Geiger presented a careful delineation of what nuclear war is and is not, avoiding espousal of the more radical predictions in the literature. Soviet mathematician Vladimir Aleksandrov's predictions of local temperature drops of over 60 degrees Centigrade, temperature increases in the Himalayas sufficient to cause unprecedented flooding, and the possibility of a nuclear-induced ice age were far more calamitous than those of Geiger.

The debate on nuclear winter is clearly not yet over, nor are the discussions on other issues dealt with by the Fourth Congress. No doubt a fifth Congress will be held, and probably many more. And while one must pay tribute to the many who have spent long hours at this work, it needs also to be said that the Fourth Congress was seriously flawed by its lack of serious self-criticism. We need to ask whether this is the best we can do, even while remembering the special sources of inspiration in Helsinki. There was the soft-spoken Eastern-bloc physician, unable to object specifically to Soviet nuclear weapons, who observed that "Every commander must have his own reserves. Big ones have big reserves, little ones have little reserves." And the doctors from Yemen, Somalia, Kenya, Mozambique and Zambia, who recognized that even oral rehydration therapy counts as nothing, compared to what an end to the arms race would do for their sick and malnourished patients. And not least, the words of John Donne, cited by Dr. Chazov: "Any man's death diminishes me, because I am involved in Mankinde; And therefore send not to know for whom the bell tolls; It tolls for thee." □

Ted Strom is a student in the M.D.-Ph.D. program at the University of Chicago and a member of Physicians for Social Responsibility.



Howard Margulies, United States

Space weapons

I wish to raise several important questions of factual accuracy regarding "Space Weapons" (*Bulletin*, May 1984) by Richard Garwin and John Pike. Before proceeding with grandiose policy recommendations partisans in the "space militarization debate" should do their homework carefully and present their points honestly.

Garwin and Pike say, "For the past 25 years, space weapons have remained largely in the realm of speculation." But in the Soviet Union at least two substantial space weapons programs have been undertaken, involving dozens of orbital tests over the last 20 years. The United States has never tested a space object as a weapon and has no plans to do so.

Regarding the U.S. Thor ASAT (antisatellite) weapon the authors write: "Neither of [its] potential missions—defense against Soviet orbital nuclear weapons and deterrence . . . seemed particularly compelling by the early 1970s." It is highly questionable to discuss this aspect without reference to the fact that between 1966 and 1971 the Soviets were indeed flight-testing orbital thermonuclear weapons, FOBS (Fractional Orbit Bombardment System), the use, but not the testing, of which was explicitly prohibited by the 1967 Outer Space Treaty.

In 1973–1974 it became clear that the FOBS program had been terminated without the relatively simple operational evolution into a MOBS (Multiple Orbit Bombardment System); very soon thereafter the Thor system was also dismantled. Under these circumstances, however, the potential Thor ASAT mission against a reasonably extrapolated MOBS was compelling, given the time-frame in which this U.S. weapon system was deployed. Failure to mention FOBS might be considered to be deliberately misleading.

Regarding the Soviet killer satellite program, Garwin and Pike say, "An onboard active radar guidance system achieved 10 successes in 14 attempts." This is at least an improvement on the standard falsifications widely promulgated about the Soviet ASAT satellite. But it is still misleading. Of the four cited failures, two were on flights made 15 years ago. One was an upper stage malfunction (which has occurred in less than 5 percent of all SS-9 space launches); and one was on an experimental pop-up one-revolution profile (the nominal profile is two-revolution). Counting only those tests conducted since the system became operational in 1971, on the standard profile, when the booster has injected the ASAT satellite into a proper transfer orbit, the standard guidance system has worked six times out of six. This is in stark contrast to the authors' earlier reference to "the poor performance of such systems."

On the threat posed by American systems to the Soviet missile warning systems, Garwin and Pike say, "Early warning satellites can be attacked at the low points in their orbits." This is false, as the next sentence admits, since such a hypothetical mission would require significant improvements over the baseline system. Further, an attack upon an early warning satellite at perigee does no damage to existing capability for at least six hours (the early warning birds at apogee are untouched); it takes six hours for the attack to take effect. Yet later the authors say that surprise is important for such attacks.

With respect to the hundreds of American ASAT missiles, I find the image of firing "the entire arsenal . . . within a few hours" preposterous. There are not even that many potential targets. Hence the numerical "advantage" vanishes. The number of targets must be kept in mind: By 1989, the Soviets could deprive the United States of low-orbit photoreconnaissance for months by hitting just two targets. To achieve the same denial of function, the United States would have to destroy ten times as many Soviet short-lived reconnaissance satellites.

A general objection: Comparing a future U.S. ASAT capability to a ten-year-old Soviet capability is deceptive, since it assumes that the Soviets will never improve on their system. And the size comparison is also misleading, since it counts the Soviet SS-9 carrier rocket but not the U.S. F-15 aircraft. Since the American ASAT missile must be launch-

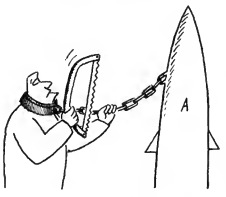
ed from such a vehicle, which has flown into the orbital path of the target satellite (usually hundreds of miles from the air base), to leave it out of the comparison is outrageously dishonest. Flight-time from launch to intercept, for example, should count the aircraft portion of the U.S. ASAT missile profile.

Like the F-15, the SS-9 space booster has numerous other missions, so the double standard of including the carrier with the ASAT in one case but not the other has confusing consequences. Some "space freeze" advocates have mistakenly asserted that the Soviet ASAT is much easier to verify since it is so much bigger than the U.S. ASAT. But of 20 SS-9 launches in 1982–1983, from several pads at two different launch sites, only one carried an ASAT. The others were practically indistinguishable in configuration—but would be exempt from any anti-ASAT treaty. The actual sizes of the *distinguishing hardware* (the ASATs) are very similar, a dilemma concealed by the Garwin-Pike tactic of including the SS-9 but excluding the F-15 from all equations.

Such unrealistic appraisals of current Soviet and future U.S. ASAT capabilities may be a prime factor in frustrating the beginning of genuine bilateral negotiations. Space demilitarization proponents who play down Soviet activites and capabilities wind up dispelling their own credibility among informed circles, however popular their assertions may be elsewhere.

In another May 1984 *Bulletin* article, and at a weekend conclave with the Federation of American Scientists and the Union of Concerned Scientists, Yevgeny Velikhov has conducted his appallingly successful media blitz. And it is a cosmic charade that many people in the West are willing to take part in the pretense that Velikhov is an honest man pursuing noble aims.

Velikhov's major thrust is that the United States is introducing militarization into the hitherto pristine reaches of outer space. He clearly is lying when he pontificates that the Soviet Union



Paul Valerry, West Germany

possesses no space weapons, particularly ASATs. Yet in the *Bulletin* he writes: "Invulnerability of satellites used for verification purposes is an important stabilizing politico-psychological factor and an indispensable technical part of a freeze agreement." And further: "An attempt to destroy the opponent's satellites . . . can be justifiably regarded as the first step in initiating unlimited nuclear war. Destruction of the satellites would give every reason to the attacked side to retaliate immediately . . . without waiting for a nuclear attack on their own launching complexes and other military and civil targets." Yet the Soviets, as Velikhov must be aware, developed the capability to do so years ago, obviously in order to have the option to carry out such a mission under some circumstances.

Velikhov calls arguments for the development of an American ASAT "completely groundless and unpersuasive" because of the authoritative and concrete Soviet declaration "to eliminate all the existing ones." But official Soviet statements elsewhere make it clear that they have nothing which needs eliminating.

Evidently, Velikhov can get away with such deceptions because his American listeners know that if they insisted that he speak the truth he would go home in a huff and not talk to them. I submit that tolerating lies is far worse than enduring silence and that the current intellectual posture of many Western "space freeze" groups encourages the Soviets *not* to engage in a dialogue based on reality. Since their dialogue based on fantasy has proven so productive in the West, there is no motivation for them to change their propaganda tactics—and no evident inducement from Western groups such as yours.

James E. Oberg
Dickinson, Texas 77539

* * *

Richard Garwin and John Pike respond: James E. Oberg urges us to do our "homework carefully and present [our] points honestly." We thought we had. Oberg criticizes us for things we did not say. Sometimes he calls us "outrageously dishonest," and sometimes he only suggests that something "might be considered to have the appearance of being deliberately misleading." Whew!

We said, "For the past 25 years, space weapons have remained largely in the realm of speculation." Had it not been for the Soviet ASAT program, we would have said "wholly." As for "the United States having never tested a space object as a weapon," how many *Bulletin* readers know that a "space object" is a technical term which means "satellite" and specifically exempts ICBM reentry vehicles and other things which are launched into space but which do not achieve orbit? Nevertheless, the United States in its Strategic Defense Initiative has every intention to test "space objects as weapons," including directed energy weapons such as particle beams, space-based lasers and the like.

Regarding the dismantling of the U.S. Thor ASAT, we *did* mention one of its potential missions, "defense against Soviet orbital nuclear weapons." But it seems to be inconsistent with Oberg's position for him to endorse the elimination of our ASAT simply because the Soviet Union stopped testing and may have scrapped its FOBS and did not allow it to progress to a MOBS. After all, if these systems employ the same boosters used in other Soviet space, as well as ICBM, systems, how do we know that the Soviets do not have FOBS and MOBS ready for use, even though they have not been successfully tested for many years?

Regarding the Soviet ASAT, Oberg praises us for providing "at least an improvement of the standard falsifications." But it is not just we who have a modest opinion of the capability of the Soviet ASAT. In 1979, after 16 tests of the Soviet ASAT, U.S. Air Force Chief-of-Staff Lew Allen told the Senate that he gave the Soviet ASAT a very questionable operational capability for a few launches and that it did not pose a very credible threat. There was one additional test since then with the radar homer, which was a success. The 1979 assessment still stands. Oberg is entitled to his opinion, but he has not only us to argue with but also the formal Air Force view.

We did say that "early warning satellites can be attacked at the low points in their orbits." This is not "false," since the "significant improvements over the baseline system" are simply to provide information and basing to aircraft in the southern hemisphere. It is quite true that such an attack upon an early warning satellite at perigee would not damage early warning capability for some time. However, it is not "at least six hours, perigee to apogee time" for the attack to take effect. Satellites in such orbits are in use 70 to 80 percent of the time, not the very small fraction of time that Oberg suggests by indicating that it is only at apogee that the absence of the satellites would be important.

If Oberg finds hundreds of American ASAT missiles excessive, we hope he will suggest saving money by buying fewer of them. Indeed, it is the burden of our paper that our ASAT does not counter the Soviet ASAT, and we certainly recognize that the Soviet ASAT could destroy long-lived satellites which would be difficult to replace. For a more detailed explanation of these views see "Antisatellite Weapons" by R.L. Garwin, K. Gottfried and D.L. Hafner in *Scientific American* (June, 1984).

Oberg takes us to task for comparing a "future U.S. capability . . . to a ten-year-old Soviet capability," arguing that it is deceptive. But we *assume* the Soviets will improve upon their system if there is no ASAT ban. In fact, the "future U.S. capability" is no longer future. The Homing Overlay Experiment test of June 10, 1984 was only nominally a test of a ballistic-missile interceptor. It is far more a demonstration of a U.S. capability to destroy low-orbit satellites by means of a ground-launched, non-nuclear interceptor. Now Oberg will have to argue that the comparison of a present U.S. capability and a Soviet capability initially demonstrated 16 years ago is in some way improper.

We did not intend to be "outrageously dishonest" in leaving out of the comparison the flight-time of an F-15 aircraft. We concealed nothing. There are certainly ways in which the relevant comparison *is* the flight-time from launch to intercept: in the availability of time for satellite maneuver, in the ability to recall the intercept before any expenditure of resources has taken place, and the like.

Whatever Oberg says about "some space-freeze advocates" has nothing to do with our article. And finally, it is hardly constructive to suggest that we "wish to whitewash Soviet activities and capabilities."

Perhaps a word might be said on Oberg's comments regarding Velikhov, although presumably Velikhov can stand up for himself. We think that it is an error in logic to suggest that Velikhov "clearly is lying when he pontificates that the Soviet Union possesses no space weapons, particularly ASATs."

We have heard Velikhov many times and read much of his writing and have not heard him say that the Soviet Union possesses no ASATs. If Oberg believes that having a capability to do something is identical in effect to the actual deed, then what does he think about our ability to destroy most of the residents of the Soviet Union or of almost any other country in the world? It is entirely possible to acknowledge that one's own country possesses ASATs and to indicate the unfortunate consequences to that country of their use.

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Plutonium connection

George Palmer and Dan Bolef in their article "Laser Isotope Separation: The Plutonium Connection" (*Bulletin*, March 1984) quoted some of my words, taken from some two dozen of my remarks in "Nuclear Inc.," a book by Mark Hertsgaard. The quotation is placed by Palmer and Bolef in the context of their argument that the nuclear industry is looking for the government to provide an economic subsidy by buying reactor plutonium for use in nuclear weapons. A small amount of scholarly research, namely reading pages 242 and 243 of Hertsgaard's book, would have indicated that the quotation was misused.

Shortly after the prosposal was made to use civilian reactor fuel for weapons plutonium production, Hertsgaard contacted me and asked for my reaction. My opposition to the proposal and the general industry opposition were reported by Hertsgaard in his book and also in a number of other publications. (See, for example, the San Francisco *Chronicle*, February 3, 1982, or the February/March 1980 issue of *Mother Jones* magazine.)

Except for overriding national need my opposition arises from two factors: First, I believe it would make the international non-proliferation task more difficult if civilian and military uses of nuclear power reactors were to be blurred. (No nuclear weapons have been derived to date from civilian nuclear power reactors.) Second, it seems to me that such a proposal, if enacted, would provide grist for the mills of those who attack nuclear power on any grounds, whether warranted or not. Palmer and Bolef have shown that my concerns on the second point are not without foundation.

Bertram Wolfe
General Electric Company
San Jose, California 95125

* * *

George Palmer and Dan Bolef's response: Wolfe is outraged and therefore may be expected to misread our article. On the other hand, he gives us another opportunity to repeat the logic of the arguments we adduce on the last page of our article.

- The civilian nuclear power industry is doing poorly.
- According to Wolfe and others the industry has no intention of calling it quits. They are, they say, looking for something that will make the economic environment more favorable to nuclear power. (This is the use to which we put Wolfe's words.)
- One possible path to viability for the nuclear industry could be through the steps we describe. Indeed, it is not unheard of that in straitened circumstances a business will sacrifice principle for profit.

In the meanwhile, we are pleased to know that Wolfe and "the general industry" oppose the use of civilian reactor fuel in the manufacture of weapons. We consider this a principled stand and support it fully.

Teaching nuclear war in West Germany

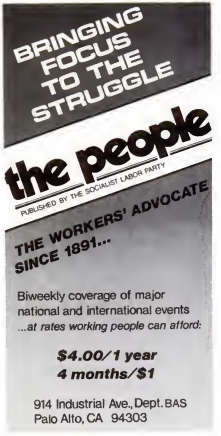
In the April 1983 *Bulletin* I reported on the nuclear weapons course which was in progress at the Technical University of Darmstadt in West Germany. Now, more than a year later, perhaps it is time to look at the background, organization and initial reactions.

This course was an attempt to introduce technically-oriented students and faculty alike to topics that span the entire range of the nuclear arms debate, as well as some of the politics involved. As important as this task may seem, it has always been very difficult to awaken interest in such issues, especially among the technical and scientific community in West Germany. This is quite in contrast with professionals in similar fields of endeavor in other countries, such as the United States. Much of this attitude has to do with European culture and history, but another factor inhibiting the present discussion is that many professors at universities in West Germany are very conservative and reject involvement in anything political, particularly something as controversial as the nuclear arms race.

Recent history reveals only one major event which involved strong participation by the West German scientific community in the area of nuclear arms. I refer to the April 12, 1957 appeal of the "Göttingen 18," signed by such respected scientists as Otto Hahn, Werner Heisenberg, Max von Laue, Fritz Strassmann, Wilhelm Walcher and Carl Friedrich von Weizsäcker, who protested plans to equip the army with nuclear weapons.

Unfortunately, such involvement by the German scientific community in matters they understand and/or are responsible for has been almost nonexistent during the past two decades whenever the sensitive nerve of politics was touched. However, attempts to reestablish this kind of tradition worldwide have been followed very closely by many West German scientists.

The July 1983 convention in Mainz, "Responsibility for Peace—Scientists



Warn against New Arms Race," which aroused considerable interest, was an attempt to recapture the spirit and tradition demonstrated by the "Göttingen 18." The convention resulted in the "Mainz Appeal," signed by over 3,000 participants. It demands, among other things, that all nuclear arsenals be frozen at present levels and that no cruise or Pershing II missiles be stationed in Europe.

The effort by Professors Kankelleit and Roeckl at Darmstadt to organize a course that would provide a forum for informative discussion among students and scientists must also be seen in this light. A list of the talks featured between November 1982 and July 1983 shows that all the important topics associated with the arms race were covered. While some of the talks were given by undergraduates and graduate students as well as members of various faculties, others were given by invited speakers. On the average, about 70 attended each week.

These meetings provided an opportunity to look at and discuss a wide range of issues within a nonpartisan and scientific framework. Whereas the large number of topics alone would have overwhelmed an individual, direct involvement by the participants allowed the workload to be distributed so that an all-encompassing course could be fashioned. The quality of the information provided was also an important factor, considering the misinformation provided by politicians and some of the media.

Unfortunately, the course did not succeed in attracting many undergraduates, but it did result in the formation of a coordinating group of graduate students to assist in the organization of such courses in the future as well as to help disseminate information. There was a definite consensus among the participants that West German universities should take a more active role in familiarizing science students with the problems of the arms race.

Plans call for continuing this course.

Peter Somssich
Amherst, New Hampshire 03031

Big brain

"Irresistible, Irrational, Indomitable Military Technology." So reads the title of Etienne Bauer's article in the May *Bulletin*. Maybe we're sleepwalking in the grip of evolutionary change.

There are more extinct species of animals than living ones on this Earth. Dinosaurs are, of course, the classic example. Also the paleozoic trilobites, the vast numbers of eocene herbivores and carnivores whose fossils are found in the Dakota badlands, and the pleistocene sabertooth tiger whose two front teeth grew so long they fenced off his mouth. We all know how the rate of extinction has increased in recent times.

Adaptations favorable to survival have sometimes, under changed conditions, become detrimental. What anatomical feature, so far, has most favored *Homo sapiens*' survival and dominance? Big brain. As the theologians say, we are now, with our nuclear weapons, in a "new dispensation," and our "big brains" bid fair to do us in.

Everett Whealdon
Fort Townsend, Washington 98368

Low-level radiation

In their commentaries on the health effects of ionizing radiation in the March 1984 *Bulletin*, Catherine Thiel Quigg and Robert W. Loftin were either unaware of or chose to ignore a previous *Bulletin* exchange (February 1981) on a crucial aspect of this subject. The pieces concentrated on an unresolvable issue: the validity of the hypothesis that small incremental exposures to low-level radiation are harmful to human health. In my view, the more fundamental question is whether or not society is prepared to act on this hypothesis, rationally and consistently.

Participants in the earlier *Bulletin* discussion were in substantial agreement

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that the greatest incremental public exposure to ionizing radiation could result not from nuclear energy, but from residential energy conservation programs. Such exposure will occur if these programs continue to be carried out with inadequate attention to the deterioration in the indoor radiological environment that is likely to occur when homes are sealed up to save energy. The culprit is naturally radioactive radon gas, generated from the highly variable concentrations of radium in soil, water and building materials. When ventilation is reduced, the indoor concentration of radon can increase by amounts that would be totally unacceptable in other contexts.

The only real point of contention in the discussion was whether or not federal and state residential energy conservation programs would be revised to include substantive efforts to mitigate the anticipated incremental radiological exposures to members of the public. The pessimistic viewpoint that such revisions would not be made has, unfortunately, proven to be correct.

Politicians and government administrators feel secure in ignoring or temporizing on the indoor radiological problem because they pragmatically anticipate that the vocal critics of low-level radiation from nuclear energy will remain silent on the indoor radiological issue. Thus, while society is spending vast sums of money for tighter controls on radiation from nuclear facilities, there are no funds even to monitor properly the indoor radiological environment. In addition to the potentially adverse cumulative effect on public health and the possibility of future litigation growing out of alleged negligence in the implementation of federal and state energy conservation programs, the absence of systematic measurements will necessarily detract from future epidemiological studies of the presumed relationship between indoor radon and lung cancer.

Self-perpetuating delusions regarding controllable public exposure to low-level radiation from different sources may result not so much from a deliberate desire on the part of activist organizations to deceive the public as from the human frailty of being unwilling to accept facts that are incompatible with prior convictions. The authors of future *Bulletin* articles on public exposure to ionizing radiation should overcome this frailty and address their subject with greater objectivity and consistency.

Henry Hurwitz, Jr.
Schenectady, New York 12309

* * *

Catherine Thiel Quigg's response: The existence of radon pollutants in the residential environment in no way diminishes concern for tritium which, in the form of tritiated water, has been assigned one of the highest permissible body burdens for any radioisotope by the International Commission on Radiological Protection.

When experiencing an excess of radon pollutants in the residential environment, one can, by increasing ventilation, dramatically reduce the concentration of pollutants. To minimize energy requirements for heating and cooling outside air, the use of mechanical ventilation with a heat exchanger or the re-circulation of air through high-efficiency particulate filters have been recommended by some experts. As Henry Hurwitz suggests, much work remains to be done in the area of radon research, measurements and standards.

The incorporation of tritium in drinking water or water vapor in the workplace is more difficult to remedy. Since tritium closely follows the reactions of ordinary hydrogen, it assimilates readily into water and into biological systems. Conventional concentration processes such as ion exchange and evaporation do not remove appreciable amounts of tritium from liquid effluents. The U.S. Nuclear Regulatory Commission does not require their licensees to filter the tritiated water out of their nuclear power plant effluents because no economically feasible technology exists to do the job. As a result, tritium may comprise between 50 and almost 100 percent of the total radioactivity in nuclear reactor discharges.

As more commercial and military nuclear reactors come on line, tritium will build up in the environment at an increasing rate—especially in small, confined waterways. It is not too early to consider the health effects of drinking water contaminated with even low concentrations of radioactive tritium. As I commented in my article (*Bulletin*, March 1984), the research of Dieudonne J. Mewissen and R. Lowry Dobson should serve as a warning of potential human health problems.

* * *

Robert W. Loftin's response: Henry Hurwitz and I do not disagree. My essay was a short history of ionizing radiation, which pointed out that the fear of ionizing radiation is not based on an

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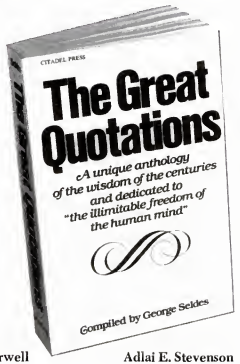
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irrational reaction to anything that happens to be new. At the outset, radiation was not viewed with alarm, and actually became a health fad.

Since that time, the historical trend has been to discover that less and less radiation was more and more dangerous. If anything, the discovery that shutting your house up tightly results in an increase in radon that may be deleterious to your health in some instances is another step in the *same* direction.

As I said in my commentary, "The process of learning, step by painful step, that radiation is more dangerous than we had previously thought continues."

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Proliferation

As a cast-off veteran of the Arms Control and Disarmament Agency's Nuclear Non-Proliferation Treaty and SALT campaigns, I applaud "Proliferation and Nuclear Trade" by William Walker and Mans Lönnroth (*Bulletin*, April 1984).

Your readers, however, ought to know about an even more comprehensive work by them published in 1983. Anyone interested in nuclear arms control might overlook this small, beautifully written but unpublicized book because of its somewhat deceptive title, *Nuclear Power Struggles*. U.S. administrations, and especially the next one, would be well advised, as would the American people, to pay attention to the perceptions of these well-informed overseas commentators whose basic affection for what the United States has stood for shows in their writings.

Would that Walker and Lönnroth had doubled the length of that book and fully developed some of the answers to the nuclear proliferation problems that they exposed with such well researched and factually supported insights.

Eli B. Roth
Southbury, Connecticut 06488

Weapons from reactors

K. Subrahmanyam (*Bulletin*, May 1984) states that no country has ever built a nuclear weapon using reactor-grade plutonium. This is not true. As T. Cochran, W. Arkin and M. Hoenig state in their *Nuclear Weapons Databook*, "The U.S. tested a weapon constructed with reactor-grade plutonium in 1957. . . . Using high-technology, or sophisticated design techniques, the problems presented by preignition [due to the use of reactor-grade plutonium] can be largely overcome." They also state that even the crude—by modern standards—first U.S. weapon would have still yielded in excess of one kilo-

ton if it had been constructed with reactor-grade plutonium. Finally, it should be noted that, given the capability to reprocess spent fuel to extract plutonium of any grade, obtaining weapon-grade plutonium merely requires removing the fuel sooner from the reactor. No additional technical skills are needed.

Jonathan Thornburg
Thetis Island
British Columbia V0R 2Y0
Canada

Radioactive waste disposal

The article by C.B. Hunt (*Bulletin*, April 1984) on the geological uncertainties of [solidified] high-level radioactive waste disposal was nicely done. Hunt appreciates the complexities of thrusting geology and radioactive wastes into long-term interactions—interactions the Department of Energy seems anxious to test.

These uncertainties in long-term geology predictions with high-level radioactive waste led Hunt to speculate on the advantages of long-term surface storage instead of repository disposal. This is planned in the Savannah River defense waste production facility now under construction in Aiken, South Carolina. The facility will use interim surface storage for the processed high-level waste until a licensed repository is available.

This surface storage is not without concerns. The Savannah River plant inventory of high-level waste approximates one gigacurie and will be vulnerable to warfare, terrorism or the loss of institutional protection with a collapse of society. While I am sympathetic to the deliberations of geologists, repository disposal seems a more prudent match against the uncertainties of civilization over the next few thousand years. Retrievable repository storage has the added potential of correcting the inevitable technical mistakes while minimizing the hazards of surface storage.

In his conclusions the author high-



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lights my own concerns about institutional solutions to major, expensive projects. Geologists should indeed be asking the important questions, along with physicists, biochemists and other scientists. In fact, a committee of such scientists (free from conflicts of interest) should oversee the Department and forums on high-level radioactive waste disposal.

W.F. Lawless
Paine College
Augusta, Georgia 30910

Stockpile reliability

It is not self-evident why the stockpile reliability of our nuclear deterrent needs to be maintained (with or without testing), as seems to be assumed by Hugh DeWitt and Gerald E. Marsh (*Bulletin*, April 1984).

Deterrence is in the eye of the beholder, and is based on a potential aggressor's lack of confidence that the damage from his adversary's retaliation would be "acceptable." In a comprehensive test-ban regime, strategists contemplating a first strike could never assess the deterioration of their adversary's stockpile with enough accuracy to eliminate this deterring fear. The possessor of a nuclear stockpile would feel the crucial need to know the reliability of his own weapons only when planning for their use in a first strike or in nuclear war-fighting.

Uncertainty—both with regard to one's own stockpile and with regard to an adversary's—serves as a deterrent. Further testing is not only unncessary, but potentially destabilizing.

Jeffry Larson
Hamden, Connecticut 05514

Unilateral initiatives

Why should we not go to Geneva and announce that the United States is going to dismantle a certain fraction of every category of its nuclear weaponry, within a certain time frame? This would not be a proposal; it would be an announcement. It would be a matter over which we we would have full control. It would not depend upon Soviet reaction or response. All we would ask of the Soviets would be that they send observers to attest to the fact that we really did what we promised. (Moreover, their presence would serve to remind us of what we had said—and this would help us to do it.)

Presumably, the answer is that it is preposterous to suggest such an action in the present political climate. Not until there are enough people who have seriously thought through the requirements for survival could such an action be taken.

The success of my suggestion is, of course, predicated on the hope, if not the assumption, that the Soviets, being realistic and as desirous of survival as we, after being convinced of our good faith, would respond in kind. If one can be allowed a flight into fantasy, perhaps a new kind of arms race could be initiated: a race to see which side could dismantle nuclear weapons faster.

If my analysis is at all correct, it points up the tremendous importance of the effort the *Bulletin*, and others, are making to help people see that their survival lies in "unilateral initiatives." The great dilemma, as I see it, is whether enough people can be convinced soon enough to outrun the catastrophe.

J. Merle Harris
Minneapolis, Minnesota 55418



Thomas Cheney, United States
"Fellow Americans . . ."

Congratulations

I offer my congratulations for your May 1984 issue. The comments by Alan P. Lightman and Etienne Bauer, along with the special supplement on "Space Weapons" by both American and Soviet authors, with American and Soviet proposals for treaties, are most important in showing that we can work together as well as against each other.

Lightman is to be particularly congratulated for his psychological insight and his account of its development. When we have not slain the dragons of our minds with the knights and swords of our minds, we end up pursuing them in the real world.

From the dynamics of individuals, Bauer takes us to group dynamics. The technological pursuit of dragons and dragon slayers goes on separately and secretly from the work of those knights who have reentered the real world as diplomats. Although in one sense those diplomats may still be pursuing fantastic as well as real dragons, they have sublimated their own sociopathic tendencies toward treating that pathology. A government that sees only its own aim is displaying the character flaw of a lack of any conscience, or at least a very large lacuna in its conscience. As with individuals, only when each government is able to admit that it is a mix of good and bad will it be freed of the tyranny of its mental split.

Articles by Richard Garwin and John Pike along with Yevgeny P. Velikhov in the same publication, and the presence of the two proposed treaties on facing pages, are a demonstration that the pathology can be recognized and treated, thus offering visions of hope. However, it remains for the patients—each government—to accept that they are imperfect and in need of help. Although the human process of recognizing, accepting and then letting go of its own badness is a slow and arduous one, the bittersweet rewards of following this path are well worth it.

Leon Morton Green, M.D.
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